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FLIGHT

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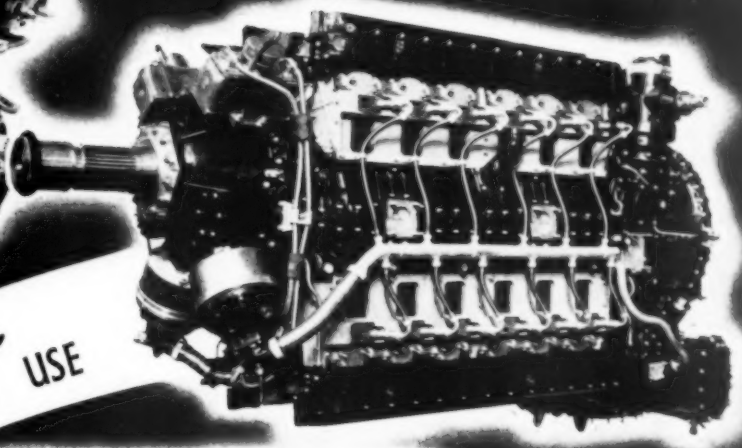
The AIRCRAFT ENGINEER AND AIRSHIPS

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

BRITISH AIRCRAFT INDUSTRY NUMBER

(II) Engines and Equipment



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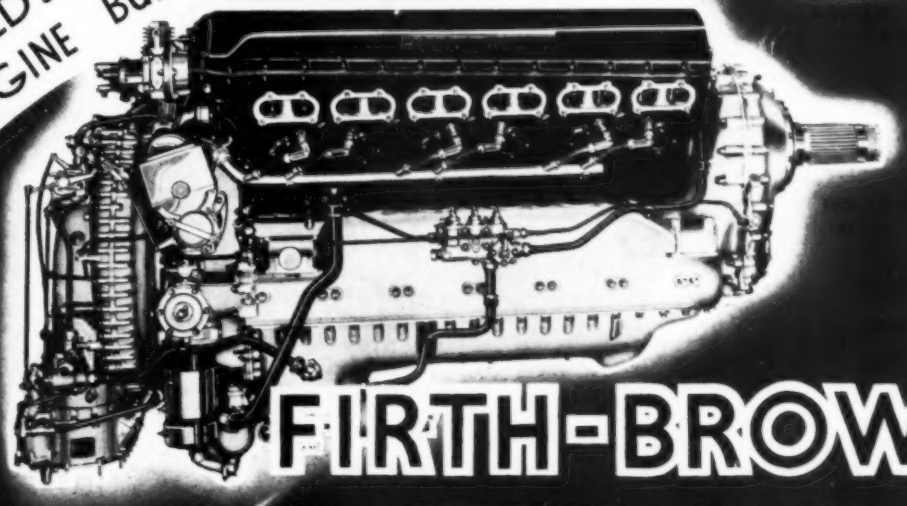

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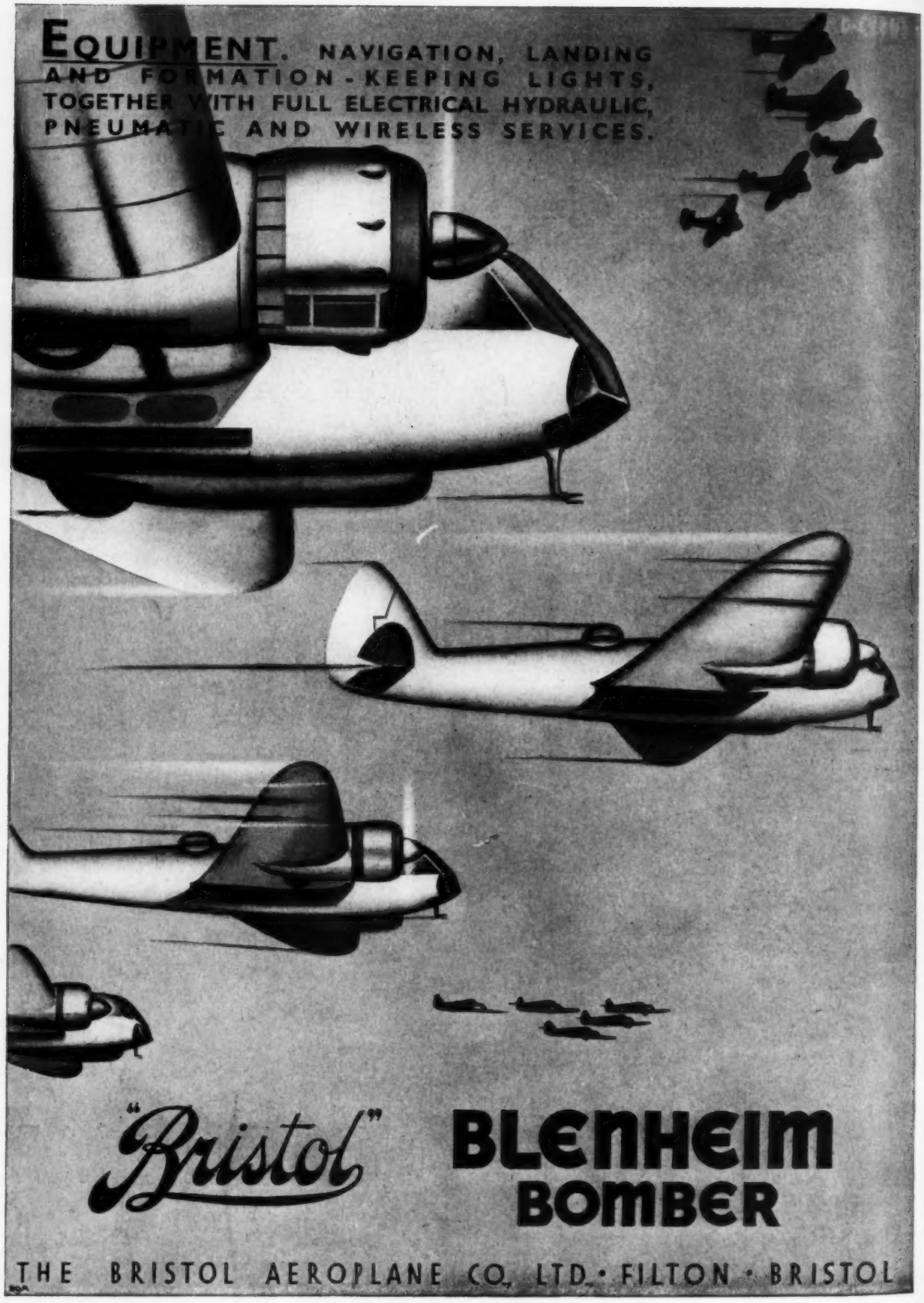
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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

This Vast Industry

IF any reminder of the expansion of the aircraft industry is required, this issue of *Flight*—the second of our special British Aircraft Industry Numbers—assuredly supplies it.

Last week we described complete civil and military aircraft, reviewing the products of a score of firms. This week we deal with manufacturers of engines, aircraft equipment and materials to the number of over 500. Two years ago our review of the industry embraced barely half this total.

Comprehensive as this guide is, it would be presumptuous to claim that it is "complete." Working outwards from the aircraft on the "House that Jack Built" principle, we could demonstrate that an almost unlimited number of concerns had some share, direct or indirect, in its production or operation. But our notes on the activities of 500 firms still serve to show how willing are these organisations to assist the expansion programme and how capable and well equipped they are.

Even more important, perhaps, is this proof that the aircraft-proper industry has such a magnificent source of supply to draw upon when the present abnormal conditions and a real programme of civil aircraft construction for the world market can be embarked upon.

It is *Flight's* hope that these two special issues will form a really useful work of reference to all who may want to check up quickly on the products of any particular firm. Of the ordinary reader requiring little beyond an occasional reference to aircraft or engines we would claim indulgence, pointing out that our regular features and special articles covering all aspects of the subject of aviation will be resumed next week.

Mr. Caldwell Speaks His Mind

AFTER listening to Mr. Cy. Caldwell's deservedly savage attack on British aviation, and rearmament in particular, at the Royal Aero Club last Thursday (duly reported, with reservations, on page 410) it was difficult not to believe that if a fearless critic of the Caldwell calibre could speak, say, every month before a mixed gathering of trade and Air Ministry officials it would be a good thing for all concerned. At last week's House Dinner Mr. Caldwell was given full freedom to say exactly what he pleased, and we have only ourselves to blame if what he said was not altogether liked.

The whole clue to Mr. Caldwell's opinion of us appeared in his opening remarks about the "pits" which were dug during the crisis. They demonstrated our complete inability to deal realistically with the situation. We prepared half-heartedly for war while hoping vaguely for peace. Either we should have gone all out for peace at any price or we should have dug holes of a size, construction and number sufficient to take the entire unevacuated population. We did neither, but scraped feebly around largely with the idea of comforting the civilian population. Therein lies our present weakness—indecision.

Almost daily one hears stories, exaggerated or otherwise, of inefficiency and even carelessness in the organisation of the rearmament programme, and Mr. Caldwell merely said outright what a large number of people are thinking. The fact that after two and a half years of spending there are gaps in our defences has already been publicly stated, but the blame cannot definitely be assigned. Everyone makes mistakes, and, as Mr. Caldwell was careful to point out, there is nothing the matter with the means of production; the fault is with the organisation as a whole. And the seat of this organisation is, of course, the Air Ministry.

Those at the top undoubtedly know the faults of the system and are doing what they can to remedy them. It is, unfortunately, the ever-present failure in bureaucracy that there should be duplication and delay and that no single person should be in a position to say yea or nay to a particular project. The specification, or whatever it is, must go the rounds of the departments. The result is an inevitable delay.

Aftermath

WITHOUT upsetting the system as it is, surely it should be possible, where important matters are being considered, for all the heads of the different departments to get together there and then around a conference table. This, apparently, is the method of the Admiralty, and we know of one case where a dozen departmental heads drove out to a factory and discussed a new machine continuously during a whole day, until every item in the layout and equipment had finally been decided upon. The result was that work was put in hand within weeks instead of months.

One or two speakers in the discussion which followed Mr. Caldwell's diatribe inferred that the fault was with the democratic system. Surely the word democracy need not necessarily be a synonym for inefficiency. If the system of Government in this country were changed overnight to one in which a single person or group of persons had dictatorial powers neither Mr. Caldwell nor any other person would be permitted to criticise or make suggestions. Freedom of speech and thought should, if this freedom is properly directed, prevent both injustice and inefficiency. The failure in this case is not in the form of Government, but in the methods by which the decisions of such a Government are carried out.

But, as one of Mr. Caldwell's listeners remarked afterwards, we are probably much too certain of ourselves to be affected in the least by such a thoroughly deserved cold douche as that provided last Thursday.

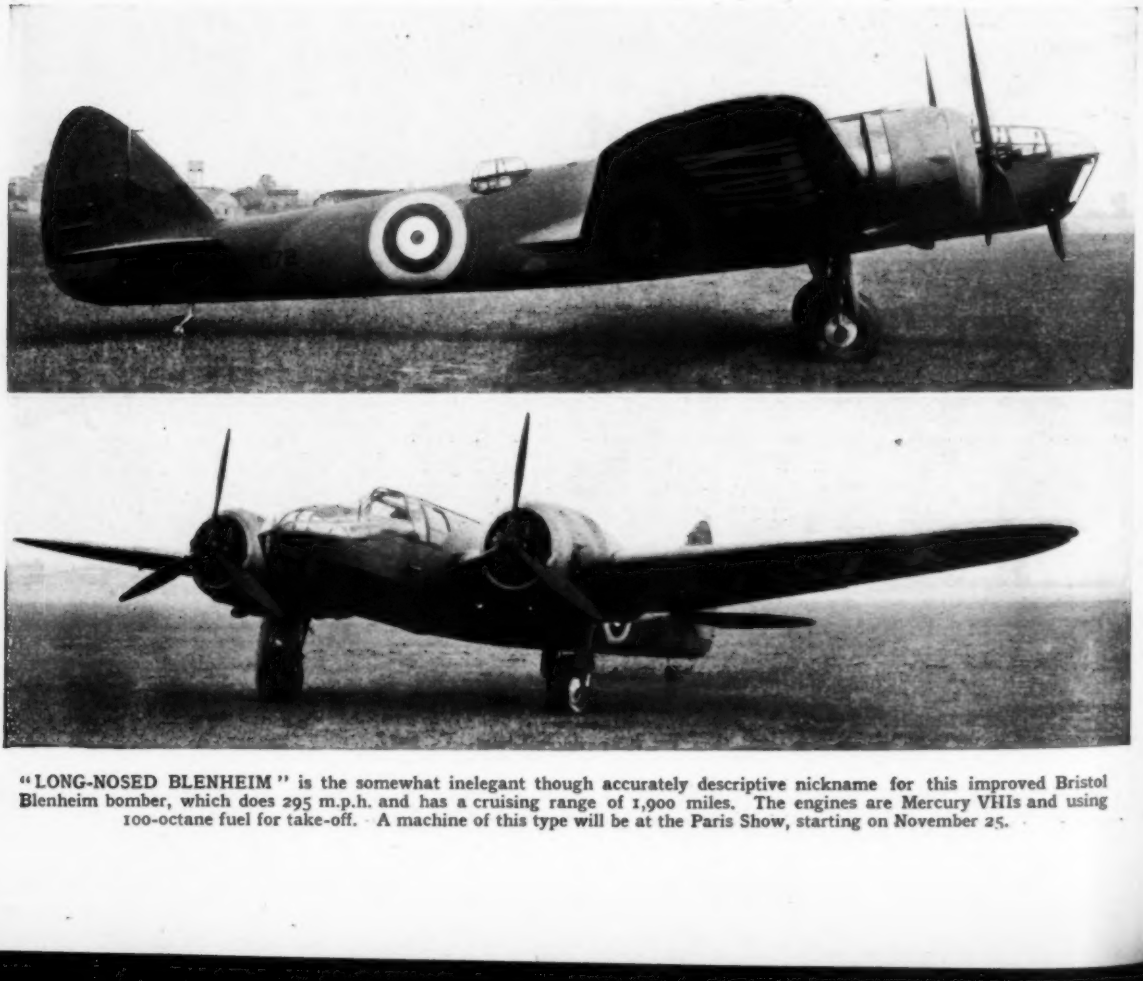
Control of Flying

BY its terms of reference the new Gorell Committee on the control of flying will be able to spread its net almost as wide as it likes. The general idea is that the Committee has been set up mainly to examine the regulations concerned with low flying over towns, but the wording of the terms of reference is such that there is no logical reason for that assumption. "Flight of aircraft over populous *and other districts*" is the phrasing. If it means anything at all it means flying over the middle of Dartmoor no less than flying over the centre of London. However, the safeguarding of the general public is not likely to be difficult except over towns, so to that extent the main task of the Committee may be assumed to be the examination of existing regulations.

At present the rule is that an aircraft must not fly over a town below a height from which it can reach open country in the event of engine failure. That regulation was framed in the days when engine failures were not the extremely rare occurrence which they are now, and the intensity of traffic was not such as to make the risk to the public a very serious one. Conditions have changed a great deal in the meantime, and it has become very necessary to get the position defined much more clearly.

The danger to life and property does not now arise from mechanical defects. The main causes of possible accidents are deliberate disregard of the regulations and the possibility that a pilot flying in poor visibility may, in coming down to get his bearings, be over a town. The latter risk may be rendered almost negligible by the use of radio, and the former comes within the purview of the Committee via the words, "and the adequacy of the means of their (the regulations) enforcement."

Composed as it is to a considerable extent of practical pilots, the Committee should be well qualified to examine and recommend solutions of the many thorny problems with which it will be faced.



"LONG-NOSED BLENHEIM" is the somewhat inelegant though accurately descriptive nickname for this improved Bristol Blenheim bomber, which does 295 m.p.h. and has a cruising range of 1,900 miles. The engines are Mercury VIIIs and using 100-octane fuel for take-off. A machine of this type will be at the Paris Show, starting on November 25.

PRIVATE FLYING

MOST OF MELBOURNE: The Percival Vega Gull which is used by the Shell Company of Australia, photographed when flying over the capital of Victoria. The distinctive colour scheme is interesting, though it makes a peculiar difference to the natural lines of the machine.

Topics of the Day

Flap Technique

A FEW weeks ago I mentioned the fact that pilots seemed to me to be developing a special technique for emergency use with the present-day type of aeroplane with which the old-fashioned forced-landing methods are impossible. In brief, the method involved the use of a certain proportion of the flap movement during the early part of the approach, and keeping always, in reserve, the rest of the movement for last-minute height adjustment.

After spending, recently, an hour or two in a machine in which the flap angle could be altered through a very large number of positions, I am convinced that in the ability to make full use of such adjustment lies the whole secret of forced-landing safety.

This may appear to be merely stating the obvious, but one finds so many pilots who, even when various positions are available, tend to use only two of them—down and up. Either they sit over the aerodrome boundary, pull the nose up to lose speed and plug on full flaps there and then, or else make an unflapped approach and use the full movement to slow down a somewhat over-fast gliding speed just as the machine is crossing the boundary markers.

Such methods in regular practice are all very well when an engine is always available for stretching a glide. Of the two, the use of full flap from the start is the least pernicious. In that case one is, at any rate, in possession of the means for stretching the glide. A scheme such as that in which a stop is arranged in the flap-control movement would certainly be useful to prevent those awkward moments following any attempt to stretch this glide at the very last minute, or after a fatal bit of overshooting.

Variable Control

A LITTLE practice with a machine having a fully variable flap control proves that, if one's speed is kept up within reasonable limits, there should never be any possibility of making a mess of a forced landing. In the course of perhaps a dozen approaches with the aforementioned machine in strong and variable wind conditions, I never once, except of my own volition, found it necessary to use the engine to reach the landing area.

All that had to be done was to apply more or less flap angle according to the way in which the aerodrome boundary appeared to be in its correct place or otherwise. On the one occasion when I went so far as to raise the flaps altogether in order to make sure that the aerodrome would be reached, I felt that the evil effects of so doing must have been grossly exaggerated in the telling. The effect was simply that the steep, flaps-down angle had to be changed to the more nose-high attitude of the unflapped glide, and obviously the flaps could be raised much more quickly than the nose.

Certainly, all flaps, and those air brakes of any real potency, should be arranged with a variable control—preferably with a stop to prevent flaps from being raised altogether in awkward circumstances. With such a control one can feel safe in ignoring the throttle altogether and in treating the flap lever as the sole means of approach adjustment—rather after the manner of the device sug-

Private Flying

gested by Sqn. Ldr. Fraser in his very sensible lecture for the Royal Aeronautical Society last December. Here was a knowledgeable person talking from the point of view of the man who has to do the flying. So often one listens to expert theorists who on no account ever leave the ground and consequently have no idea of the many peculiar difficulties involved in, for instance, flying heavily loaded transport types.

Old-fashioned Advantages

WHILE on the subject of wing loadings, I sometimes suspect that the days of comparatively safe and useful private air travel may have gone. Wing loadings are going up and the features of the modern type of machine are not at all conducive to comfort and safety in small-field work.

When using an aeroplane to go from here to there in all weathers there seem to be only two really useful types. One is the comparatively lightly loaded machine which can be manœuvred almost below tree-top level and put into very small spaces in case of emergency. The other is a full-grown aeroplane with a couple of power units and full blind-flying and radio equipment. The half-way type cannot really be used except when flying in reasonably reliable weather.

The old type of light aeroplane could not only be manœuvred at low altitudes and within small spaces (witness the Moth which landed a fortnight ago on Tooting Bec Common), but, even more important, could be flown out of similar small spaces with equal safety (witness the departure, on the following morning, of the same Moth). Most of these heavily flapped up-to-date devices can, in fact, be put down in very tiny spaces, but when the weather lifts, or morning dawns, it is necessary to ring up the nearest civil aerodrome and have the machine dismantled and ignominiously towed away—which does not help much when the pilot hopes to reach some destination as soon as possible.

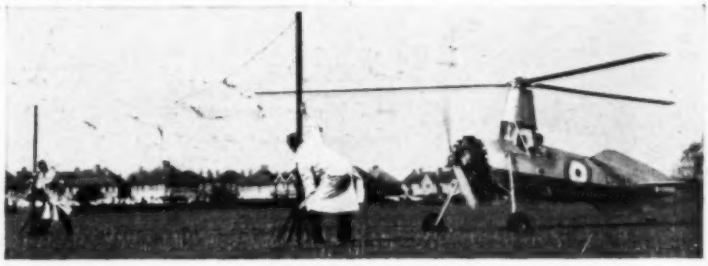
The fully equipped alternative is still fairly impossible for any but a private owner who is rich enough to employ a trained crew. He may be capable of and enjoy flying the machine in reasonable weather, but only the professional pilot can be trusted to fly blind for long periods and to make an accurate landfall on a succession of radio bearings; and only a professional radio operator can produce this same succession of bearings with any degree of accuracy or speed.

I confess to being something of a reactionary in this matter, and cannot help hoping that manufacturers will always continue to build light aeroplanes with at least some of the old characteristics, yet with modern ideas in comfort and luggage-carrying capacity. Several owners have, from time to time, used their aeroplanes to travel backward and forward to work over quite long distances during the summer months. One of them, to my knowledge, used to fly something like eighty miles in all kinds of weather morning and evening, and, though he is quite accustomed to flying up-to-date aeroplanes, he still swears by the old trainer biplane for such work. With it he can fly down valleys, turn round trees and, when necessary, put down in fields to wait for better conditions.

Incidentally, what is a stuffed cloud? Answer: A cloud with a mountain in the middle of it. INDICATOR.

JUMP-START PROGRESS

The Two-seater C.40 Autogiro Demonstrates Its Capabilities



THE latest Cierva Autogiro—the C.40—ordered for the Army and the Fleet Air Arm, shows its paces, piloted by Mr. Marsh. The two pictures were taken from the same viewpoint, the upper showing the machine in position ready for the jump-start. On the right it is seen clearing the tape. The engine is a 170 h.p. Salmson. This is the first jump-start two-seater Autogiro. The experimental C.30, on which the early tests were made, carried a pilot only.

SERVICE AVIATION

Royal Air Force and Official Announcements : Fleet Air Arm News : Military Aviation Abroad

H.R.H. the Princess Royal at Halton

ON Saturday last H.R.H. the Princess Royal inspected the hospital at Halton which was opened by herself on October 31, 1927, and is named Princess Mary's Royal Air Force Hospital. When opened, the hospital had 204 beds; it now has 535, and is one of the most modern of all Service hospitals in its equipment.

The New Aircraft Carrier

H.M.S. *Ark Royal*, the new 23,000 ton aircraft carrier, will commission at the yard of Cammell, Laird & Co., Birkenhead, on November 10, for acceptance trials.

Canadian Stranraers

CANADIAN VICKERS, LTD., of Montreal, are building a series of Stranraer flying boats for the Royal Canadian Air Force. The news has been received that the first one has successfully made its test flights.

The Long-range Flight

FOUR Vickers Wellesley machines of the long-range development flight left Upper Heyford on Tuesday, October 25, for Egypt. Wing Cdr. O. R. Gayford, who commands the flight, accompanied them in a fifth machine. The flight, which started at 6 a.m., landed at Malta at 2 p.m., and arrived at Ismailia, on the Suez Canal, the same evening.

Miles Kestrel Trainer—A New Engine

THE new performance figures announced in *Flight* last week for the Miles Kestrel Trainer were somewhat lower than those obtained with the original machine. The explanation is that the prototype had a Kestrel XVI engine giving a maximum output of 740 h.p., whereas the model in production for the Air Ministry has the Kestrel XXX, a specially developed unit with an output of only 585 h.p.

It is likely that the Service type Kestrel Trainer will differ somewhat from the original machine, particularly as regards the rear portion of the fuselage and the tail.

The Wireless Reserve

MEMBERS of the R.A.F. Civilian Wireless Reserve received their first general exercise on the night of last Saturday, October 29.

The exercise was radiated from a Royal Air Force transmitting station to 200 reservists, scattered throughout Great Britain. The reservists have been organised under 12 regional controllers during the last fortnight. They have now been notified of call signs, operating signals, wavelengths and times of instructional broadcasts.

Since the Secretary of State for Air, Sir Kingsley Wood, made his appeal for reservists, more than 3,000 applications have been received by the Air Ministry from amateur wireless telegraphists throughout Britain. Of this number 700 have already been enrolled. When the recent international crisis developed 100 members of the Civilian Wireless Reserve were called upon to prepare for mobilisation. Though the warning came as a surprise practically all these volunteers responded.

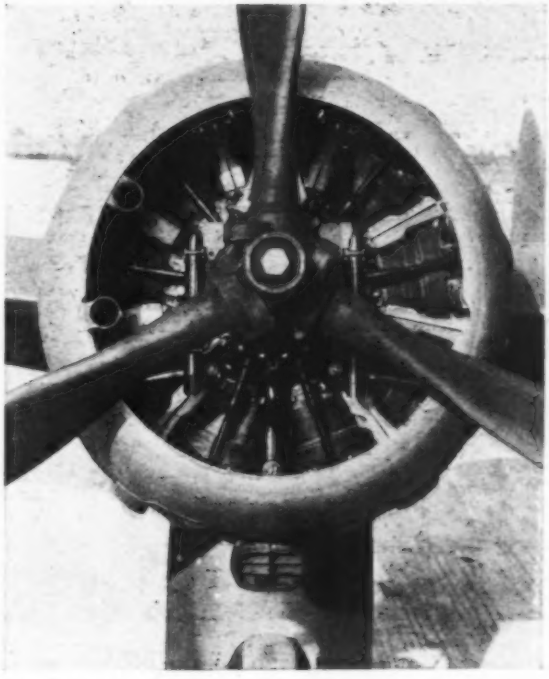
A button badge has been designed and approved for the organisation. It is a shield surmounted by the eagle of the Royal Air Force. In the centre is a double-bladed axe with lightning radiating from it on the background of Air Force blue with the letters "R.A.F.C.W.R." beneath.

A Revised Blenheim

ANNOUNCEMENT has just been made of a considerably improved version of the Bristol Blenheim twin-engined bomber and the first pictures of the type to be released appear in this issue. Although following the layout of the original Blenheim as now in service the internal equipment has been rearranged and a new nose piece incorporated. This extends the length of the machine by about 3ft. and is designed to provide increased facilities for navigating, etc. The new section houses a chart table, instruments and a folding seat and affords improved bombing facilities. Due to its special shape it gives an exceptional field of view forwards and downwards.

Another improvement takes the form of additional fuel tankage in the wings bringing the range up to 1,900 miles in still air, presumably at a nominal cruising speed of 200 m.p.h. It may be recalled that the range of the previous type of Blenheim was 1,125 miles.

The new machine, like its predecessor, is fitted with two Bristol Mercury VIII engines but facilities are provided in the new type for the use of 100-octane fuel for take-off. This fuel raises the take-off output of the Mercury VIII from 725 h.p. to 920 h.p. and gives the same take-off characteristics as with the older version, despite the increased load. The same crew—pilot, navigator and wireless operator/gunner—is carried as well as the same load of bombs.



HUNDRED OCTANE : One of the Bristol Mercury VIIIs in the 295 m.p.h. "long-nosed" Blenheim introduced in this issue. Take-off output, on 100-octane fuel, is 920 h.p.

The top speed of the new machine is even higher than that of the standard Service type, of which there are already many hundreds in service. The figure given for the nominal maximum speed is no less than 295 m.p.h. This, together with the long range makes the new Blenheim a most formidable weapon. Incidentally, it should be explained that the 100-octane fuel is used solely for take-off, the pilot switching over to his main tanks of "87" after he has left the ground.

There can be no doubt that in its new form the Blenheim is a considerably more effective weapon than, for example, the latest version of the German Dornier Do.17 with which the type is usually compared.

Royal Canadian Air Force

THE Royal Canadian Air Force has been reorganised into three commands. There will be a Training Command with headquarters at Toronto; an Eastern Command with headquarters at Halifax, Nova Scotia, and a Western Command which will include all units in British Columbia and Alberta.

Turret Improvements

A METHOD has been patented by Capt. Fraser-Nash of retracting and fairing aircraft gun turrets. Essentially the invention consists in fairings which move with the turret and cover the opening in the structure through which the turret is extended. Typically the fairing is in two halves, each of which has arms pivoted on some adjacent portion of the airframe and connected with two segments engaging toothed racks to which motion is imparted prior to, or during, the extension of the turret.

The Bristol Company and Mr. L. G. Frise have patented a device for closing the traversing slot of a turret in every position of the gun.

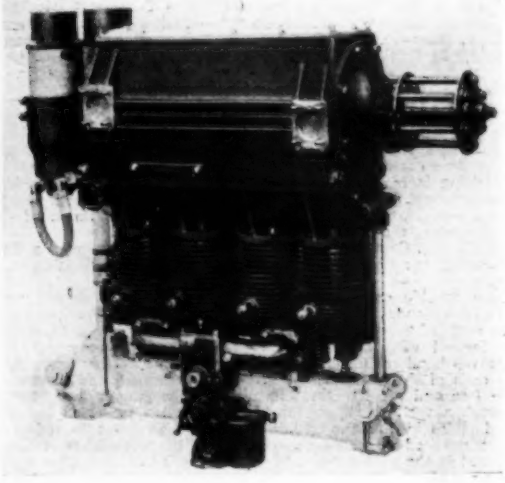
In a specific embodiment of the invention (nose or tail turret) the slot extends horizontally through about 180 deg. around the fore part of the turret. The top and bottom edges of the slot are formed with opposed channel-shaped guides in which slides a canvas band reinforced with narrow vertical wooden battens. At the ends of the slot the guides continue rearward and may constitute fore and aft structural members. The gun or guns protrude through a vertical slot in the band and when traversed the whole band slides in the appropriate direction. In order to reduce the effort required to move the band and to prevent it becoming jammed in the guides the ends may be connected to tension springs, rubber cords or the like.

BRITAIN'S AERO ENGINES

New Lightweights : Sleeve-Valve Progress : Two-speed Superchargers : A Detailed Review

THE leading position of Britain's aero engines, which was apparent when *Flight* presented its review last year, has been well maintained. In fact, it is fairly safe to claim that our supremacy in many fields has been even further assured, not so much by the introduction of new engines (though these are very much in evidence), but by development of established types.

There is no doubt that the Rolls-Royce Merlin is predominant in the liquid-cooled class; that the Bristol sleeve-valve units are still unchallenged; that the latest Napier Dagger sets a new mark in the extraction of high power from a small volume; and that our new inverted fours-in-line are destined for very big things in the development of lightweight aircraft.



Destined for some interesting prototypes the little Pixie inverted four in line is now manufactured by Aero Engines, Ltd., of Bristol.

AERO ENGINES LTD.

ORIGINALLY produced by the Weir concern, the little 50 h.p. four-in-line engine, suitable for light aircraft of up to 1,200 lb., is now known as the Pixie and is marketed by Aero Engines, Ltd.

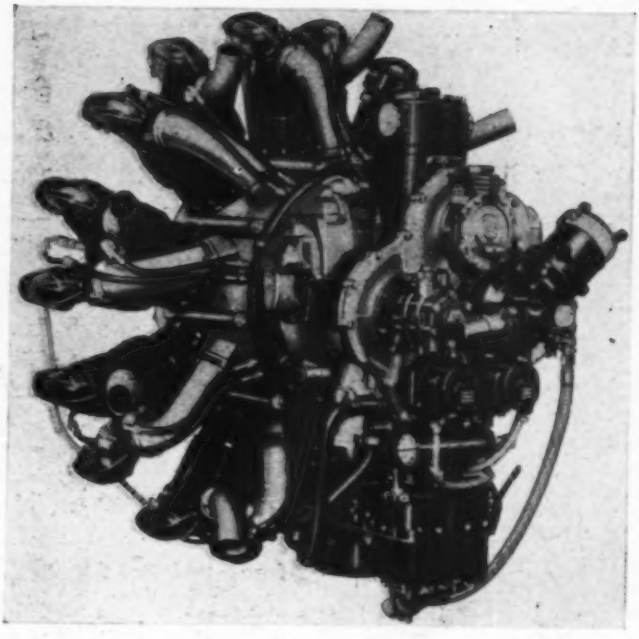
The crankcase and cylinders are of unit construction and are cast in heat-treated magnesium alloy. The hardened cast-iron liners are detachable, and the top cover provides easy access to the crankshaft.

This latter component is of nitralloy steel and is carried by three main bearings, the front and rear having bushes in magnesium alloy and the centre being of lead bronze. Thrust is taken by a ball journal. All bearing journals and crankpins are hardened.

Connecting rods with split big-ends are made from duralumin "G" stampings and run directly on the crank and gudgeon pins. Castings of "Y" alloy are used for the pistons, which have two-compression and two scraper rings.

The cylinder heads are cast in pairs from Ceralumin "C" alloy. There is one inlet and one exhaust valve per cylinder. Phosphor-bronze valve guides are employed, and the combustion chambers are fully machined with K.E.965 inserts for 14 mm. sparking plugs.

The hollow camshaft is housed in a box under the cylinder heads and is carried on three magnesium alloy bearings. The drive is by gearing to a vertical shaft at the rear of the engine. Eccentrics are provided on the camshaft for operating one or two fuel pumps as required. The valves have nitrogen-hardened stems, the exhaust valves also having stellited seats and tips. Oil pumps are of the gear type running at half engine speed. Oil from the tank is forced by the pressure pump through a cloth filter to the main and big-end bearings. One hole is also provided in the crankshaft extension to supply oil to the



Small diameter and general compactness characterise the new Alvis Leonides nine-cylinder radial.

gears which are housed in the rear cover. The camshaft bearings and cam faces are lubricated via the hollow camshaft by a low-pressure system which is supplied by oil from the scavenge pumps. All other parts are splash lubricated. Oil drains from the crankcase by tubes at either end of the cam box. Two scavenge pumps are provided, one at each end of the camshaft; that at the front end delivers oil through the camshaft to the rear end, whence it is delivered to the oil tank.

An Amal carburettor is fitted, the mixture being distributed by means of a symmetrical "T"-shaped induction pipe to a common inlet port, to Nos. 1 and 2 cylinders and similarly to Nos. 3 and 4 cylinders. The hot, scavenged lubricating oil is circulated through a muff surrounding the induction pipe immediately above the carburettor.

At the rear, situated vertically, are two Scintilla magnetos with automatic advance mechanism, driven at half engine speed by helical gears. When the engine speed reaches 1,700 r.p.m. full spark advance is obtained. Cooling is on the "end to end" principle, an air chute being fitted on each side of the engine.

Petrol consumption at cruising speed is about 17 pt. per hour. Dimensions are: Length over airscrew hub, 32.3in.; width, 10.5in.; height, 26.5in.

MAKERS: *Aero Engines, Ltd., Kingswood, Bristol.*

ALVIS

SO far as aero engines are concerned, Alvis, Ltd., are concentrating on the nine-cylinder Leonides, which should prove an eminently suitable power plant for such aircraft as intermediate and advanced trainers.

The cylinder barrels of the Leonides are bolted to the crankcase and are of nitrided steel and fitted with "Y" alloy cylinder heads. The head is shrunk on to the barrel, and both units are very heavily finned.

Pistons are of forged aluminium alloy with cooling and stiffening fins beneath the crown.

There are two valves to each cylinder, each valve being operated by independent, completely enclosed, and pressure-lubricated rocker gear. Both valves are of high-resistance austenitic steel, the exhaust valve being sodium-cooled and having a stellited seat.

Ignition is by dual compensated cam magnetos, fully screened against radio interference.

Mixture is supplied to the cylinders through a geared centrifugal supercharger by an S.U. fully automatic carburetter with boost control. The carburetter intake is oil heated.

Lubrication is on the dry-sump principle, oil being supplied to all the principal working parts of the engine via a single pressure pump and scavenged through scavenge filters by two pumps working in tandem.

All accessory drives are taken from the gear box, which can be fitted to the rear cover of the engine or driven by a cardan-shaft. Provision is made for fitting the following accessories: Fuel pump, hand/electric starter, generator, vacuum pump, fluid pump, air compressor, revolution counter drive, and one spare drive.

It is claimed that the engine is easily installed, being supplied complete with flexible or fixed four-point mounting. It is fitted with all brackets and attachment for N.A.C.A. cowlings and pressure baffles, standard designs being available, though special designs can be developed to suit individual installations.

The airscrew is driven through a bevel-type reduction gear, alternative ratios being 0.5: 1 or 0.63: 1. The engine operates as a left-hand tractor and accommodates either a fixed-pitch, variable-pitch, or constant-speed airscrew.

Particularly noteworthy are its small overall dimensions, the diameter being only 41½in. Fitted with the 0.5: 1 reduction gear, the Leonides is 52in. long, the alternative gear ratio adding an inch. Fuel of 87 octane number is required.

Fuel consumption under economical cruising conditions is given as 0.52 pt./b.h.p./hr.

MAKERS: *Alvis, Ltd., Coventry.*

Characteristics of the Armstrong-Siddeley Tiger, Cheetah and Genet Major series may be compared in these views.

The Bristol Mercury VIII, using 100 octane fuel, delivers 920 h.p. for take-off. It is the power plant of the improved Bristol Blenheim.

ARMSTRONG SIDDELEY

ORIGINALLY an ungeared engine, the Siddeley Genet Major—smallest of the company's range—is now available with or without reduction gear. The Mark IA is a seven-cylinder radial with four main components—the front cover, the crankcase, the induction case, and the rear cover.

The connecting rods operate on a single-throw hollow crankshaft, the master and auxiliary rods being air-hardened steel stampings. The auxiliary connecting rods are secured by four grooved anchor pins and two plain ones, two of the grooved pins being located in the rod, and the remaining two grooved and two plain pins in the cap.

The assembly of the pistons and connecting rods is balanced by two phosphor-bronze counterweights (steel in the Mark IV) bolted to the two crankshaft webs diametrically opposite the crankpins.

In the case of the Genet Major IV the front cover—bolted to the forward face of the crankcase—encloses the reduction gear.

The cylinder assembly comprises a high-tensile steel barrel screwed and shrunk into an aluminium-alloy head, the two units being further secured by a drilled locking ring which also acts as two additional cooling fins.

Bolted to the rear face of the crankcase is the impeller, which rotates at crankshaft speed.

The Genet Major Mark III is exactly similar to the Mark IA, except for the cylinders, which are of the Mark IV type.

Next in order of size is the well-established Lynx, a seven-cylinder model which is too well known to warrant detailed description.

Of a special interest at the present time in view of their extensive adoption for installation in light reconnaissance machines and trainers, the Siddeley Cheetah is available in four models—V, VA, IX, and X—all with a volume of 13.65 litres. The following notes will be confined to the Cheetah X, latest of the series and the first medium-powered engine in regular production to be designed for use with a variable-pitch airscrew. It is worthy of remark that many parts are interchangeable with other Cheetah models.

The Cheetah X is made up of the following principal components. The front cover, to the lower part of which is secured the oil pump unit and which carries also the control valve for the v.p. airscrew; the crankcase, which houses the crankshaft and connecting rod assembly and to which the cylinders are secured; the induction case, which carries the supercharger rotor; and, finally, the rear cover. This latter component contains the rear drive shaft and carries the two B.T.H. magnetos, the auxiliary drive box, the generator, and the carburetter with variable-datum boost control and automatic mixture control.

The crankshaft is a one-piece single-throw, high-tensile steel forging, and is fitted with two phosphor-bronze balance weights bolted to the crank webs diametrically opposite the crankpin. It is carried in two roller bearings, one of which is in a steel housing in the front face of the crankcase, the other being carried in a similar housing in the diaphragm plate, which closes the rear end of the crankcase. Further support is given to the crankshaft by the front end thrust ball-race, which is a driving fit in the forward face of the front cover.

The cylinders are each in two parts—the aluminium-alloy head and the steel barrel. There are two valves for each cylinder, the stem of the exhaust valve being filled with sodium. Each valve has two springs, a weak inner spring being employed in conjunction with a strong outer one to obtain a uniform loading throughout the engine. The valves are operated by a cam drum, tappets, push rods, and rockers. These latter are of a similar pattern both for inlet and exhaust, and each is fitted to the front end of a rocker standard, which, while free to float axially on the top of a cylinder head, is anchored at its inner end to the bottom of the head by a nut and split pin.

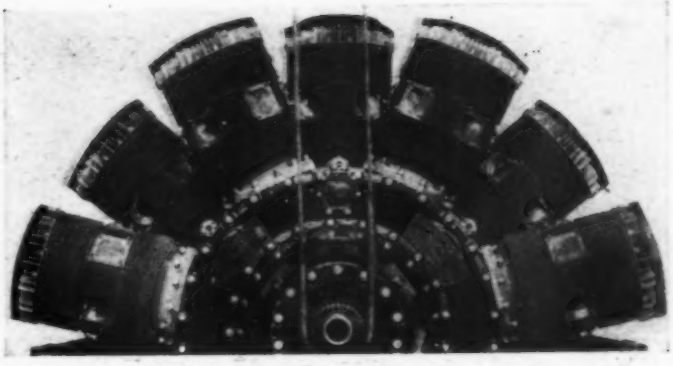
Adjustment of the valve clearance is effected by slacking off the inner and outer cone nuts, which secure the eccentric rocker fulcrum pin, and rotating the pin. Turning the pin so that the eccentric approaches the cylinder head diminishes the clearance, and when the eccentric is remote from the cylinder head the clearance is the greatest.

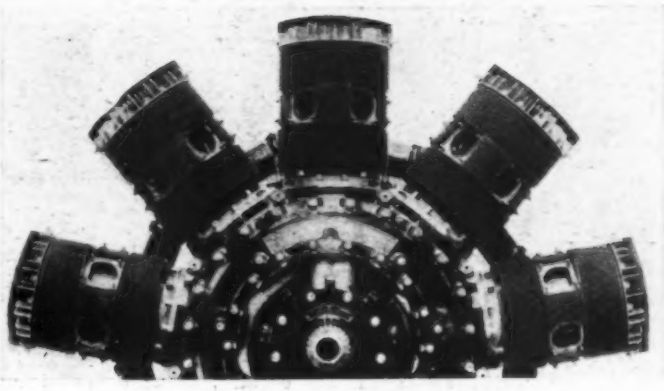
Cylinder Fixing

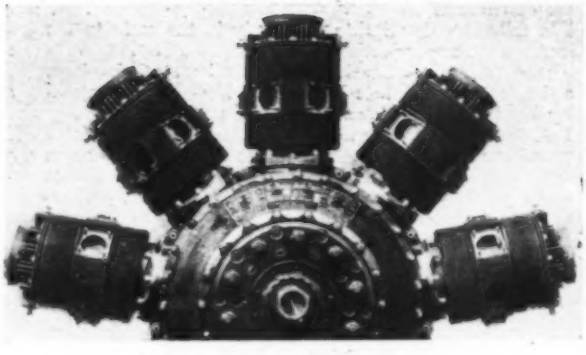
A spur gear keyed to the crankshaft and secured by a locknut drives a train of satellite gears from which power is transmitted to a set of satellite pinions mounted on the same spindles. Gears and pinions are mounted on phosphor-bronze bushes, and the latter are enmeshed with an internally toothed stationary timing gear bolted to the front face of the crankcase. The cylinders are fixed to the crankcase by an Armstrong Siddeley patented method. A steel adaptor, threaded internally, is inserted in the crankcase cylinder socket from inside the case. This adaptor has a number of holes and is prevented from turning by a peg which passes through one of these holes and through the hole drilled in the crankcase cylinder socket, the peg being secured by a circlip. The cylinder barrel has an external thread machined on it to correspond with the internal thread on the adaptor, and the adaptor carries a flange which beds on the inner face of the crankcase cylinder socket to prevent its being pulled out of the case as the cylinder is screwed home. When the cylinder is finally screwed up, the flanges of the valve ports should be parallel to the front face of the crankcase, but should the cylinder be incorrectly positioned a pencil mark is to be made on the cylinder socket and the cylinder removed. The adaptor must then be marked to correspond with the mark on the cylinder socket, and the adaptor must be unpegged and turned a sufficient number of holes to allow the mark of it to come nearest the front of the engine and re-pegged. The cylinder may then be refitted and secured by the cylinder barrel locking ring. The latter is a very important part, since it controls the compression ratio.

The induction case is separated from the crankcase by a diaphragm plate, which carries the gears necessary for driving the supercharger together with the crankshaft spring drive. The drive is taken from a spur gear fitted on the rear end of the crankshaft to a pinion on the fan

From top to bottom are detail views of the Bristol Hercules, Perseus and Aquila sleeve-valve engines. The Perseus is the first of the sleeve-valve series to go into large-scale production. It is specified for some interesting new military and civil types.







layshaft, which also carries the fan layshaft gear. From the pinion, power is transmitted to the fan layshaft gear through a centrifugal friction clutch consisting of six phosphor-bronze clutch pads in a steel housing, the latter being incorporated in the gear which in turn drives a spur gear on the fan spindle.

Drives for the auxiliaries are enclosed in a box on top of the rear cover, the generator on the Cheetah X being mounted on top of the box.

There are two current models of the fourteen-cylinder two-row Tiger—the Mark VIII and the Mark IX—the former having the distinction of being the first aero engine with two-speed supercharger to go into production in this country. The medium supercharged Tiger IX powers the A.W. *Ensign*.

Two-speed Supercharging

The two-speed supercharger of the Tiger VIII, combined with the v.p. airscrew, provides great advantages in take-off power and output at altitude, together with great fuel economy under cruising conditions. The two-speed supercharger is assembled direct to a support plate, bolted and enclosed within the induction casing. The supercharger rotor is driven from the crankshaft by a countershaft drive in high gear and a planetary drive in low gear. The gearing comprises a set of three balanced compound planets comprising a small and a large pinion housed in a carrier which is allowed to rotate in low gear position and is held stationary in high gear. There is also an internally toothed annulus which meshes with the smaller pinions. This has a flange which, when held stationary, gives the planetary drive. Driving gear, which is integral with the spring drive on the rear end of the crankshaft, is coupled by means of an internally and externally toothed sleeve to the small planet pinions which, in turn, drive the larger pinions. The smaller pinion is keyed to the spindles driving the centrifugally operated clutch within the larger planet pinion which drives the rotor shaft. The planet carrier is held stationary when required by means of an internally toothed clutch plate having toothed engagement with the outer diameter of the carrier.

This plate forms the high-gear clutch plate, and the annulus gear already mentioned forms the clutch plate for low gear. Either of these can be held stationary by a clutch which takes the form of two annular members. These members mesh with a stationary housing, and a small rotational movement will cause sufficient axial movement to lock either clutch plate, according to the direction of rotation. Rotation of the clutch actuating members is by two toggles, each having one link mounted on a pivot on the stationary member and the other link mounted on a pivot on the control member. The centre pivot points are connected to a hydraulically actuated piston in each end of a double-acting cylinder. This cylinder is connected to the oil pressure system of the engine controlled by a hand-operated piston valve. When this valve is pulled outward, oil is forced through a passage in the cylinder wall to the ends of the cylinder and forces the pistons inwards, the oil between them being exhausted through a port behind the valve (low gear). In the other extreme position of the piston valve, pressure oil is carried to the heads of the pistons, forcing them away from each other, the oil at each end of the cylinder being exhausted through ports in the cylinder (high gear).

MAKERS: *Armstrong Siddeley Motors, Ltd., Coventry.*

ASPIN

THE salient feature in the unconventional Aspin engine is the rotary combustion chamber, which takes the form of an inverted hollow cone rotated by gearing over the top of the cylinder. As this cone revolves, a port in its side moves over the inlet and exhaust ports, thus providing communication with the combustion chamber. The sparking plugs are cut off from the contents of the cylinder except at the actual moment of ignition.

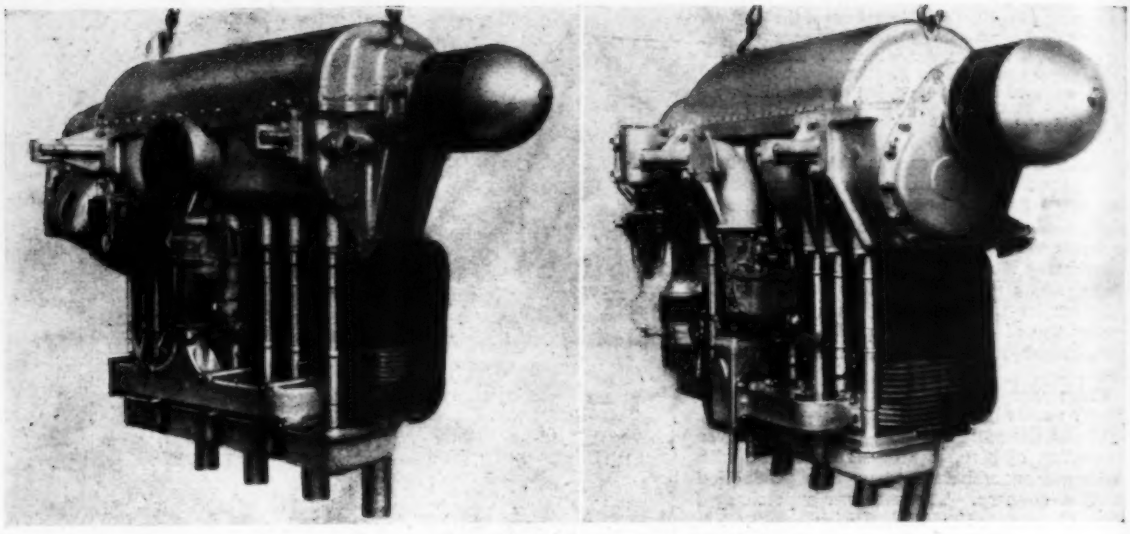
Rapid and complete combustion is claimed, and the engine can be run at very high speeds and very high compression ratios. Modifications lately made are said to improve performance considerably. Interesting developments are expected before very long.

MAKERS: *F. M. Aspin, Ltd., Egyptian Mills, Elton, Bury, Lancs.*

BRISTOL

THE current Bristol range of air-cooled radials comprises the Mercury and Pegasus poppet-valve engines and the Aquila, Perseus, and Hercules sleeve-valve models.

The Mercury (now giving 920 h.p. for take-off with 100-octane fuel) was developed primarily for installation in



These adjacent views afford a direct comparison between the Cirrus Major 150 (left) and the Minor.

high-performance military machines (it is produced in fully and moderately supercharged forms); the Pegasus is fitted to aircraft of all types, military and civil, except single-seater fighters; the Aquila is a small-diameter unit with both military and civil applications; the Perseus is more powerful and is specified for several civil and military prototypes; and the fourteen-cylinder Hercules, the most powerful type-tested engine in the country, is also destined for extensive employment in the very largest types of aircraft.

The following description will apply in the main to the Pegasus and Mercury series.

The cylinders are machined from alloy-steel forgings, the bores being surface-hardened. Forged aluminium-alloy heads are shrunk and locked in position.

Full-skirted pistons are used, being machined from aluminium-alloy forgings. There are one single and one double scraper ring and two gas rings. Connecting rods are of I section machined from nickel-chrome steel stampings. The one-piece big end of the master rod bears directly on the floating bush of steel, lined inside and out with white metal.

The crankshaft, machined from alloy steel stampings, is in two pieces; the front half incorporates the large-diameter crankpin. There are two main roller bearings with a deep groove journal bearing at the reduction gear end, and a small white-metal steadying bearing in the rear.

The crankcase is machined from forgings of aluminium-alloy, and is split on the centre line of the cylinders, being held by nine through-bolts.

Two inlet and two exhaust valves are provided, the latter being sodium-cooled and stellited. The guides for the inlet valves have oil seals to prevent leakage under high boost pressures. A Claudel-Hobson carburetter is specified. This has a delayed-action acceleration pump, variable datum automatic boost control, and slow-running cut-out. An automatic mixture control is included on the engines with two-speed supercharger.

The supercharger is of the high-speed centrifugal type driven off the tail shaft through spring-drive slipping clutches. Integral with the diffuser vanes is the aluminium-alloy supercharger casing.

In the two-speed blower of the Pegasus XVII and XVIII are three radially disposed clutch units. Essentially, each consists of two small intermediate pinions, either of which can be locked to a large intermediate gear by a double-acting hydraulic clutch. The two intermediate pinions of each clutch unit engaged with two sets of teeth embodied in the main spring drive gear keyed to the crankshaft. Each intermediate gear engages with the impeller pinion which drives the impeller through a centrifugal slipping clutch. Consequently the speed ratio of the impeller to the crankshaft depends upon which of the two intermediate pinions is locked to the large intermediate gear. The higher ratio, of course, gives full supercharge and the lower ratio medium supercharge.

Ignition is by two B.T.H. or Rotax four-pole polar inductor magnetos mounted transversely on the rear cover and driven by bevel gearing from the crankshaft. Lubrication is on the dry sump principle with pressure feed, a duplex gear pump feeding oil to the crankshaft, which is drilled to distribute it to the connecting rods, cam gear, reduction gear, and supercharger.

Farman-type bevel epicyclic reduction gear is used on all models. Taking a typical engine—the Pegasus XVIII—rear cover drives are available for the following items: Bristol dual fuel pump; R.A.E. low-pressure air compressor; high-pressure oil pump and 500-watt electric generator. An electric and hand starter is also fitted.

The great majority of Bristol installations to-day take advantage of the standardised long-chord cowling.

Sleeve-Valve Claims

We may recall here the advantages claimed by the Bristol Company for their sleeve-valve engines.

Operational advantages are: (1) Elimination of valve maintenance routine; (2) periods between complete overhauls are at least equal to those obtained with Bristol poppet valve engines; (3) exceptionally low fuel consumption; (4) oil consumptions initially comparable with those of poppet-valve engines, decrease with use; (5) reduction in mechanical and exhaust noise; (6) lessening of fire risk by reason of lower exhaust ring temperatures due to the use of higher compression ratio and to the more even cylinder-head temperatures. Technical advantages are: (2) Greater all-round thermal efficiency than with the poppet valve; (2) the designed valve diagram is reproduced with perfect accuracy without limit of speed by a positive sliding motion needing no springs for its control; (3) the simplicity of the whole mechanism makes for economical high-speed production; (4) the simplicity provides full scope for the evolution of more ambitious engines without necessarily entailing excessive complexity of design or disproportionate cost of production; (5) substantially higher compression and supercharge ratios may be used for a given fuel, affording greater power and economy (correspondingly, in case of emergency, a lower grade of fuel can be used); (6) deleterious effects arriving from the use of leaded fuels are much more easily avoided.

The following description of the Bristol Perseus engine includes the salient characteristics common to all the sleeve-valve types. Internal construction, up to and

BRITAIN'S AERO ENGINES (CONTINUED)

including the piston and connecting rod assemblies, follows normal Bristol practice. However, inside the crankcase front cover, in place of the familiar cam sleeve and tappet assembly, there is driven by the crankshaft a simple train of spur gears by which rotation at half engine speed is given to nine small sleeve cranks. These have their bearings in the crankcase and the front cover respectively, and their crankpins protrude rearward inside the crankcase front wall. Here each crankpin engages through a spherical and sliding coupling with the lug of its appropriate sleeve valve, which is a steel tube telescoping between the piston and the cylinder.

Due to the rotation of the sleeve crankpin at half engine speed, the sleeve valve receives a motion which combines reciprocation and partial rotation. This combined motion is such that any given point on the sleeve describes the path of an ellipse wrapped round the circumference of the sleeve and completes this closed circuit once every two revolutions of the crankshaft.

Four specially shaped ports are disposed around the circumference of the sleeve near the top. At the correct points of the cycle for inlet and exhaust these ports, due to the motion of the sleeve, traverse similar ports cut in the walls of the cylinder, progressively enlarging and then closing the resulting passages from within the sleeve to the inlet or exhaust manifold.

During the high-pressure portions of the compression and firing strokes the sleeve is at the top of its path, and its ports have risen above the level of two sealing rings in the cylinder head or "junk head." The "junk head" extension, somewhat resembling an inverted piston, protrudes into the bore of the sleeve sufficiently for this purpose. Two sparking plugs are fitted in the smooth, slightly convex face of this extension, which forms the roof of the combustion chamber.

Since the "junk head" contains a fairly deep pocket corresponding with the extension which enters the sleeve, the bottom of this pocket would ordinarily be out of the direct flow of the cooling air. An ingenious arrangement of finning and cowling, however, ensures that an air current is continually induced through it. The small splayed cowl, which is fixed to the top of each head, has rubber edges forming a seal with the ring cowling of the engine. Air is deflected by this cowl down into the pocket over the cooling fins inside and out at the rear of the head.

Construction

The cylinders are machined from light alloy forgings and the "junk heads," machined from die castings of similar material, are each fixed to their cylinders by twelve studs and nuts. Each of the nine induction pipes has a manifold embracing half the diameter of the cylinder. The latter has three inlet ports which are progressively served by the sleeve inlet ports. The two exhaust ports of each cylinder are connected by short pipes to the exhaust ring.

Apart from the fully automatic Claudel-Hobson carburetter the engine embodies another important feature—a remote gear box for all auxiliary drives except those for the magnetos, oil-pump, dual feed pump, tachometer, electric starter and, if required, the governor for the constant-speed airscrew control.

Recent engines in the Aquila, Perseus, and Hercules series include the Aquila A.E. (3M) (moderately supercharged, Aquila (A.E. 3S) (fully supercharged), Hercules II (moderately supercharged), Hercules HE (1SM) (two-speed supercharger), Hercules HE (4M) (moderately supercharged), and Hercules HE (5M) (moderately supercharged). Data for the Aquila IV are given in the table on page 390.

For a diameter of only 46 in. and a capacity of 15.6 litres this engine gives 600 h.p. for take-off at 3,000 r.p.m. and is normally rated at 470 h.p. at 4,500 ft. A fully supercharged unit of the Aquila series was installed in the Vickers Venom single-seater fighter and was applauded particularly for its smoothness.

MAKERS: *The Bristol Aeroplane Co., Ltd., Filton, Bristol.*

BRITISH ANZANI

DUE to the rush of sub-contract orders and the fact that a new type of light aero engine is in the design stage, The British Anzani Engineering Co. has discontinued the production of its vee-twin unit.

MAKERS: *British Anzani Engineering Co., Ltd., 72/74, Windmill Road, Hampton Hill, Middlesex.*

BRITISH WALTER MIKRON

BEFORE many months have passed a British version of the Walter Mikron inverted four-in-line unit with a normal output of 60 h.p. at 2,000 r.p.m. should be in production at the Opperman works.

Sales will be handled by The Chrislea Aircraft Co., Ltd., Heston Airport, Middlesex.

MAKERS: *S. E. Opperman, Ltd., North Circular Road, London, N.W.10.*

CAUNTER

MR. C. F. CAUNTER has evolved a new design, which he calls the type D, for an engine intended for the Civil Air Guard. He explains, however, that on account of the complete lack of interest in two-stroke aero engines in this country it is unlikely that a prototype will be built.

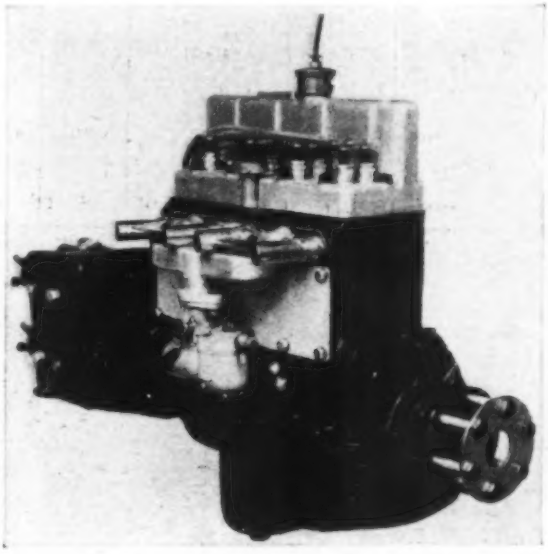
The engine is a three-cylinder inverted in-line air-cooled two-stroke with a maximum output of 50 h.p. at 2,700 r.p.m. and weighing 100 lb. The capacity is 1.9 litres. Mr. Caunter believes that it could be produced in quantity at about £65 retail.

MAKER: *C. F. Caunter, "Chryscum," Salisbury Road, Farnborough, Hants.*

CHILTON

AN adaptation of the Ford Ten car engine, the little Carden unit offered by Chilton aircraft has a large thrust bearing, optional dual ignition and various other modifications required for use in aircraft. Incidentally, it should be explained that the header tank shown on the cylinder head in the accompanying photograph is optional and is not used in that position on the little Chilton monoplane as it would interfere seriously with the cowling lines.

In spite of the weight of the engine at least two manufacturers have changed over to it from two-cylinder types



In this view of the little Chilton (Carden) water-cooled "four" the header tank is seen over the cylinder head. This is an optional position.

BRITAIN'S AERO ENGINES : DATA

Maker's Name and Engine Type.	No. and Arrangements of Cyls.	Cooling.	Bore and Stroke.	Capacity.	Reduction Gear Ratio.	Compression Ratio.	International Rating.			Maximum Altitude Rating.			Take-off Power.	Dry Weight.
							Altitude (Supercharging).	Engine Speed.	Power.	Altitude.	Engine Speed.	Power.		
AERO ENGINES.			mm.	Litres.			ft.	r.p.m.	b.h.p.	ft.	r.p.m.	b.h.p.	b.h.p.	lb.
Pixie	4 I.L.	A.	80.77×100	2.048	D.	5.58	S.L.	2,350	45	S.L.	2,624	50	—	129½
ALVIS.														
Leonides	9 R.	A.	122×112	11.78	0.5 : 1 } 0.63 : 1 }	6.3	8,500 M.S.	3,000	430	9,000	3,100	440	450	680
ARMSTRONG SIDDELEY.														
Genet Major IA ...	7 R.	A.	108×114.35	7.32	D.	5	S.L.	2,200	150	S.L.	2,425	165	—	327
Genet Major IV ...	7 R.	A.	108×114.5	7.32	0.663 : 1	5.25	S.L.	2,400	160	S.L.	2,700	180	—	367
Lynx IVC	7 R.	A.	127×139.7	12.4	D.	5	S.L.	1,900	215	S.L.	2,000	240	—	515
Cheetah VA	7 R.	A.	133.3×139.7	13.65	D.	5.2	S.L.	2,100	285	S.L.	2,400	326	—	596
Cheetah IX	7 R.	A.	133.3×139.7	13.65	D.	6.35	6,000 M.S.	2,100	310	7,300	2,425	350	340	635
Cheetah X	7 R.	A.	133.3×139.7	13.65	D.	6.35	6,750 M.S.	2,300	325/340	7,000	2,425	355	360/375	694
Tiger VIII	14 2-R.	A.	139.7×152.4	32.7	0.594 : 1	6.2	6,200 } 12,800 } 2-S.	2,375 } 2,200 }	840 } 756 }	6,000 } 15,000 }	2,450 } 2,450 }	862 } 782 }	918	1,290
Tiger IX	14 2-R.	A.	139.7×152.4	32.7	0.594 : 1'	6.2	6,250 M.S.	2,375	775/805	6,500	2,450	810	845/880	1,260
ASPIN.														
	4 H.O.	A.	83×80	1.731	—	10.2	S.L.	5,000	80	S.L.	—	—	—	130
BRISTOL.														
Mercury VIII, IX ...	9 R.	A.	146×165	24.8	0.572 : 1 } 0.50 : 1 }	—	13,000 S.	2,400	795/825	14,000	2,650	840	730	990 (+5)
Mercury XI, XII ...	9 R.	A.	146×165	24.8	0.50 : 1	—	3,500 M.S.	2,400	790/820	6,000	2,750	855/890	800/830	990 (+5)
Pegasus Xc	9 R.	A.	146×190.5	28.7	0.50 : 1	—	4,500	2,475	785/815	5,250	2,600	830	920	1,025
Pegasus XVII, XVIII	9 R.	A.	146×190.5	28.7	0.572 : 1	—	4,750 } 14,750 } 2-S.	2,250 }	780/815 720/750	3,000 } 15,500 }	2,600	1,000 } 885 }	965	1,100 (+5)
Pegasus XIX, XX ...	9 R.	A.	146×190.5	28.7	or	—	8,500 S.	2,250	800/835	10,000	2,600	925	835	1,025 (+5)
Pegasus XXII, XXIII	9 R.	A.	146×190.5	28.7	0.50 : 1	—	4,000 M.S.	2,250	810/850	6,250	2,600	915	1,010	1,025 (+5)
Perseus X	9 R.	A.	146×165	24.9	0.5 : 1	—	14,500 S.	2,400	700/730	15,500	2,750	880	750	1,085
Perseus XI, XII ...	9 R.	A.	146×165	24.9	0.572 : 1 } 0.500 : 1 }	—	6,500 M.S.	2,400	715/745	6,500	2,750	905	830	1,085 (+5)
Perseus XIIC ...	9 R.	A.	146×165	24.9	0.5 : 1	—	4,000 M.S.	2,250	680/710	6,000	2,600	815	900	1,090
Aquila IV	9 R.	A.	127×137	15.6	0.5 : 1	—	4,500 M.S.	2,600	450/470	6,000	3,000	540	600	—
Hercules	14 2-R.	A.	146×165	38.7	0.44 : 1	—	5,000 M.S.	2,400	1,150	4,000	2,750	1,375	1,290	—
CHILTON.														
Carden	4 L.	W.	63.5×92.5	1.172	D.	6.6	S.L.	3,300	30	S.L.	3,500	32	30	141
CIRRUS (Blackburn).														
Midget	4 I.L.	A.	85×100	2.27	D.	6	S.L.	2,300	48	S.L.	2,600	55	48	165
Minor	4 I.L.	A.	95×127	3.605	D.	5.8	S.L.	2,300	82	S.L.	2,600	90	82	227
Major 150	4 I.L.	A.	120×140	6.33	D.	5.8	S.L.	2,000	138	S.L.	2,450	150	132	325
COVENTRY VICTOR.														
Neptune III	4 H.O.	A.	85×80	1.5	D.	6.7	S.L.	3,000	40	S.L.	—	—	—	130
DE HAVILLAND.														
Gipsy Minor	4 I.L.	A.	102×115	3.759	D.	6	S.L.	2,250	80	S.L.	2,600	90	80	210 (+5)
Gipsy Major I ...	4 I.L.	A.	118×140	6.124	D.	5.25	S.L.	2,100	120	S.L.	2,350	130	130	300
Gipsy Major II ...	4 I.L.	A.	118×140	6.124	D.	5.25	S.L.	2,400	140	S.L.	2,400	140	—	310 (±5)
Gipsy Six I	6 I.L.	A.	118×140	9.186	D.	5.25	S.L.	2,100	185	S.L.	2,350	200	200	450 (±7½)
Gipsy Six II	6 I.L.	A.	118×140	9.186	D.	6	S.L.	2,400	205	S.L.	2,400	205	205	469 (±7½)
Gipsy Twelve ...	12 I.V.	A.	118×140	18.372	0.667 : 1	6	7,500	2,400	405/420	7,750	2,450	410/425	525	1,058
NAPIER.														
Rapier V	16 H.	A.	89×89	8.830	0.390 : 1	7	10,000 S.	3,500	305/315	13,000	4,000	330/340	335	720
Rapier VI	16 H.	A.	89×89	8.830	0.390 : 1	7	4,750 M.S.	3,650	355/370	6,000	4,000	380/395	365	713
Dagger III	24 H.	A.	97×95	16.8	1 : 2.69	7.75	3,500 M.S.	3,500	700/725	5,000	4,000	780/805	760	1,305
Dagger VIII	24 H.	A.	97×95	16.8	—	—	—	4,000	845	8,750	4,200	1,000	955	—
POBJOY.														
Niagara III	7 R.	A.	77×87	2.835	0.468 : 1	6	S.L.	3,300	88	S.L.	3,650	95	95	156
Niagara V	7 R.	A.	81×87	3.130	0.4375 : 1	—	S.L.	4,000	125	S.L.	4,600	137	119	185
J.A.P.														
"Twin"	2 H.O.	A.	114.3×101.6	1.860	D.	5.2	S.L.	2,400	34	S.L.	2,650	40	40	115
ROLLS-ROYCE.														
Kestrel XIV, XV, XVI	12 V.	C.W.	127×140	21.3	0.632 : 1	6	11,000 S.	2,600	690	14,500	3,000	745	670	955
Kestrel XIV, XV, XVI (v.p.)	12 V.	C.W.	127×140	21.3	0.477 : 1	6	12,250 S.	2,750	715	14,500	3,000	745	745	985
Merlin II	12 V.	E.G.	137.2×152.4	27	0.477 : 1	6	12,250 S.	2,600	900	16,250	3,000	1,030	890	1,335
Merlin X	12 V.	E.G.	137.2×152.4	27	0.477 : 1	—	2,500 } 13,250 } 2-S.	2,600 }	1,040 965	5,250 } 17,750 }	3,000 }	1,145 } 1,025 }	1,065	1,394

A. = Air. W. = Water. C.W. = Composite water. E.G. = Ethylene Glycol. R. = Radial. 2-R. = Two-row Radial. H. = "H" formation. V. = "V" formation. L. = In Line. I. = Inverted. H.O. = Horizontally opposed. D. = Direct Drive. S.L. = Sea Level. S. = Supercharged. M.S. = Moderately supercharged. 2-S. = Two-speed Supercharger.

with highly satisfactory results. At the time of writing, the Chilton-Carden is specified for five prototype machines in this country.

Chilton Aircraft, Hungerford, Berks.

CIRRUS

MAJOR 150, Minor and Midget engines make up the current Cirrus range of inverted four-cylinder in-line air-cooled engines.

The Major 150 uses a type of cylinder similar to that employed for the Minor. This is machined all over from a steel ingot and is located in the crankcase by a large spigot and four short studs. Cylinder heads are castings in Y alloy and are detachable, being spigoted on the cylinder and secured by twelve studs. In combination with a laminated cooper washer this is claimed to produce an absolutely gas-tight joint. The cylinder head forms one half of the valve gear box and is fitted with an Elektron cover acting as an oil bath for the valve mechanism.

The Y-alloy pistons are of the full-skirted type with fully floating gudgeon pin located by circlips. Each has two compression and one scraper ring in the head of a scraper ring down in the skirt.

Hiduminium forgings are used for the connecting rods. The white metal bearings have steel shells ground to ensure a perfect fit in the rod.

The crankshaft—a steel forging—is carried in five plain bearings with a ball thrust bearing at the front end. The camshaft is also carried in five plain bearings and is driven through a simple train of spur gears.

The carburettor is a Claudel-Hobson down-draught type. A flame trap is fitted so that warm air is taken from inside

BRITAIN'S AERO ENGINES (CONTINUED)

the cowling. Two B.T.H. magnetos, one with an impulse unit, are standard.

The crankcase is an aluminium alloy casting with all pressure oil ways carried internally. A dual Amal fuel pump is fitted at the rear.

The oil pump is of the triple oscillating piston type and is also carried at the rear of the crankcase. Integral filters are provided.

The B.T.H. inertia starter is driven by a small electric motor driving the engine through a reduction gear. On pressing the starter button the starter speeds up and automatically engages with the crankshaft at a predetermined speed. A flywheel is fitted in order to smooth out the action.

Much of the above description applies also to the Minor engine. In this model, however, the heads are clamped to the cylinders by eight studs and the induction manifold is in three pieces. The centre portion of the manifold, an Alpax casting, is the heater muff. The crankcase is an Elektron casting.

The new Midget engine has been under development for some time. This type gives a maximum output of 55 h.p. at 2,600 r.p.m., and, like the Major and Minor, is destined for some interesting prototypes. The manufacturers describe the engine as being built on "cheap but sturdy" lines.

Although the original Midget embodied a monobloc casting containing the cylinders with side valve, the current type has cast-iron cylinders located at their base by four holding-down bolts and the heads are integral with the cylinders. Overhead-valves gear is fitted operating through enclosed rockers and push-rods from the camshaft. The airscrew is directly driven. On the side of the engine is an Amal petrol pump with hand-operating levers. An Amal flame trap is fitted in the induction system.

Complete with single ignition, one petrol pump, controls, cooling chute, airscrew boss, spinner, oil drain pipe, induction system, enclosed rocker gear and bearer feet, the weight of the Midget should be about 155 lb. (± 5). Fuel should be consumed at the rate of 2¼-2¾ gal./hr. at cruising r.p.m. (2,200-2,300) and the oil consumption should be about ¾ pt./hr.

A Midget will be exhibited on the Cirrus stand at the forthcoming Paris Aero Show.

MAKERS: *The Cirrus Engine Division of Blackburn Aircraft, Ltd., Brough, E. Yorks.*

COVENTRY VICTOR

STYLED the Neptune III, the Coventry Victor horizontally opposed four-cylinder engine of 16 h.p. and 1½ litres capacity sells for £75. A 10 h.p. and a 12 h.p. type are also available (Neptune I and II), their prices respectively being £65 and £70.

Neptune engines embody an Elektron crankcase with a large outer ball-race taking airscrew loads. White-metal bearings carry the crankshaft and big ends. Standard equipment includes two carburettors and a B.T.H. magneto.

MAKERS: *The Coventry Victor Motor Co., Ltd., Coventry.*

DE HAVILLAND

UNTIL comparatively recently the De Havilland range was confined to the four-cylinder Gipsy Major and Gipsy Six (though Gipsy's I, II and III had given outstanding service before those models were introduced), but lately the company has introduced the Gipsy Twelve and the Gipsy Minor, both of which should find wide application.

The Major is now offered in two forms—the standard Major Series I and the Series II version which has been developed to run on leaded fuels and to drive a variable pitch airscrew.

The Gipsy Major I is a four-cylinder inverted in-line unit with cylinder barrels machined all over from carbon steel forgings. Wall thickness and depth of finning are adjusted to ensure even cooling and to prevent distortion. The detachable heads are of aluminium bronze and are held to the crankcase by long steel studs.

The slipper-type pistons have fully floating gudgeon pins located by external circlips and washers and one scraper and two compression rings below the gudgeon pin.

A nickel-chrome-alloy steel forging, the crankshaft is statically and dynamically balanced and runs in five white-metal main bearings, there being a ball bearing to take the thrust at the front end. The crankcase is an aluminium-alloy casting, the lower half of which carries the main crankshaft bearings. Elektron is used for the top cover.

A Claudel Hobson down-draught carburettor supplies the engine. Up to the highest cruising speed this draws, through a flame trap, warmed air from the side of the engine. When the throttle is fully opened an interconnected flap is moved and cold air is taken from outside the cowling. This arrangement prevents freezing at cruising r.p.m. and there is no loss of performance at full throttle. Oil is drawn from an external tank by an engine-driven gear type pump. Ignition is by two B.T.H. magnetos carried on platforms on the timing gear casing. Rotax electric, B.T.H. electric or Rotax hand turning systems can be employed for starting.

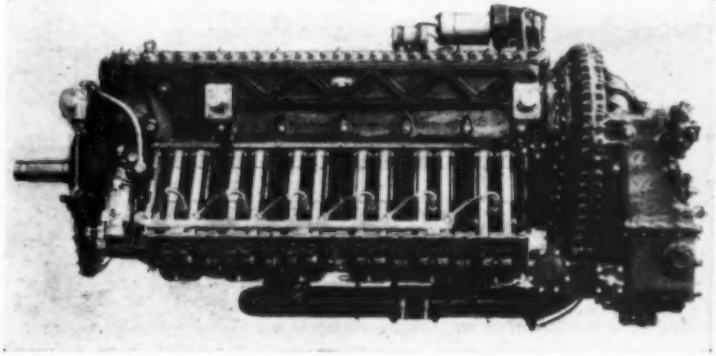
The Latest Major

The Gipsy Major II has a compression ratio of six to one and detachable heads of aluminium alloy. Dome-topped pistons, stellited exhaust valves and stronger valves springs are other new features. The oil pressure for the De Havilland variable-pitch airscrew is controlled by a two-position valve worked by the pilot and is taken from an auxiliary release valve on the filter and oil-pump unit by way of an external flexible pipe to a drilled passage in the airscrew shaft.

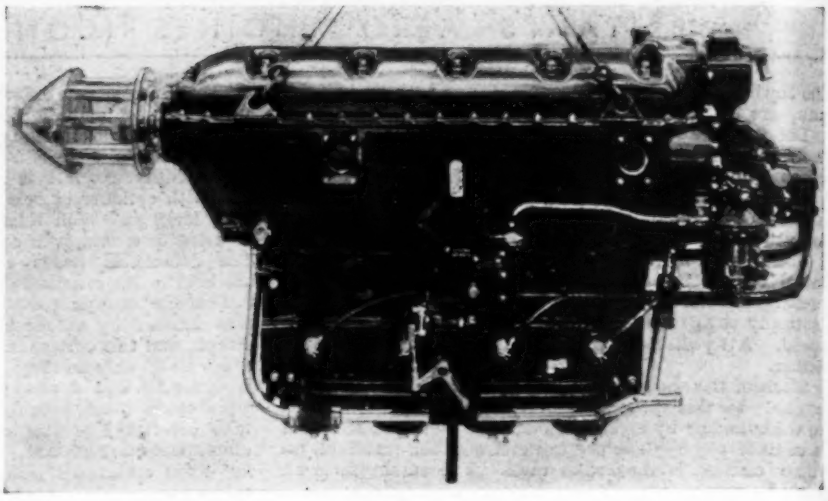
Many of the features enumerated above are common also to the Gipsy Six engines available, like the Major, in Series I or Series II forms.

The crankcase is of Elektron and has a small pump at the back end. Each intermediate bearing is supported by a stiff cross-member with a separate cap. Carburation is by two Claudel Hobson down-draught carburetters each supplying three cylinders and working in conjunction with the anti-freezing arrangement described in connection with the Gipsy Major.

The Series II Gipsy Six runs on leaded fuel and, though its maximum output under fixed pitch conditions is not greatly in excess of that of the Gipsy I engine, it offers higher consistent outputs over the cruising range and a considerable increase in take-off power, thanks to the use



It will be gathered from this view of the De Havilland Gipsy Twelve that the engine lends itself to a cowling of excellent form



A "preview" of the De Havilland Gipsy Minor which will be seen for the first time at the Paris Show.

of a variable-pitch airscrew.

By far the largest of the De Havilland types, the Gipsy Twelve, known to the Royal Air Force as the Gipsyking, offers low frontal area and, in conjunction with a specially developed cooling system, low cooling loss and excellent streamline form.

Cylinders, valve gear, etc., are essentially similar to those of the Gipsy Six II. The crankcase is an Elektron casting with seven cross webs and reinforced on each side by integrally cast webbing. Additional strength is given by two transverse bolts at the centre main bearing. There are two steel camshafts, each with twelve integral cams. The supercharger is bolted to the rear of the crankcase and driven by a long shaft, splined at its front end into a coupling at the rear of the airscrew shaft, and at its rear end into another coupling which drives through a layshaft the impeller of which sucks mixture from an S.U. carburetter.

Even newer is the little Minor intended specifically to meet a new demand for a power plant for light aircraft of simple type where robustness, economy and ease of maintenance are paramount requirements.

The crankcase and top cover are cast in magnesium alloy, the main bearing studs extending through the cover on each side of the crankshaft centre line. The main bearing housings are formed half in the top cover and half in the crankcase, ensuring rigidity.

The nickel-chrome alloy steel crankshaft is balanced statically and dynamically and rotates in six main bearings. Of "H" section, the connecting rods are machined from heat-treated aluminium alloy forgings and have drillings in their big ends to allow oil to lubricate the cylinder wall and small end bearings by splash. Pistons are of the full-skirt type with two compression and one scraper rings.

Cylinders are carbon steel forgings machined externally to form cooling pins and ground internally. The heads are aluminium alloy castings and are held to the cylinder barrel by four high tensile steel studs screwed at their upper ends to the crankcase. The camshaft rotates on the starboard side of the engine, being driven from the rear of the crankshaft by spur gears. The whole of the valve gear is enclosed and is lubricated by splash from the rockers dipping into an oil reservoir formed in the valve rocker casing covers. The train of timing gears is housed in an extension on to the crankcase and is not under a separate cover. Mixture is supplied by a Zenith down-draught carburettor on the port side. Oil is drawn from a separate tank by a gear-type pump situated on the rear of the engine.

The Gipsy Minor is designed to operate on fuel not inferior to 70 octane. This embraces almost any high-grade of automobile fuel, while the special high-expansion steel valve seatings and stellited exhaust valves permit the use of leaded fuels.

MAKERS: *The De Havilland Aircraft, Ltd., Hatfield, Herts.*

This Review of British Engines is continued on page 392a.

Forthcoming Events

NOVEMBER.

Thurs., 3rd. R.Ae.S. Lecture*: "The Meteorological Problem of the North Atlantic," by Capt. F. Entwistle, B.Sc.

Tues., 8th. R.Ae.S. Students' Section Lecture†: "Wind Tunnels," by E. A. Wright.

Tues., 8th. R.Ae.S. Isle of Wight Branch Lecture: "Aircraft Instruments," by Sqn. Ldr. Saker.

Tues., 8th. Institution of Engineering Inspection: Opening of Manchester Branch; Principal Speaker, Lt. Col. H. W. S. Outram, C.B.E., T.D., A.R.S.M., F.R.Ae.S., A.M.I.E.E.; 7.30 p.m., Manchester College of Technology.

Wed., 9th. R.Ae.S. Lecture*: "American Aircraft," by T. P. Wright, F.I.Ae.S., F.R.Ae.S.

Wed., 9th. R.U.S.I., Lecture: "The Spanish Civil War," by Wing Cdr. A. W. H. James, M.C., M.P.; 3 p.m., Royal United Service Institution, Whitehall.

Thurs., 17th. R.Ae.S. Lecture*: "The Work of the D.V.L.," by Dr. F. Seewald.

Thurs., 17th. R.Ae.S. Coventry Branch Lecture: "Ice Formation," by E. Taylor, Liberal Club, Union Street, Coventry.

Fri., 18th. Brooklands Four-club Annual Dinner and Dance, Grosvenor House, London.

Tues., 22nd. R.Ae.S. Students' Section Lecture†: "Meteorology," by F. Entwistle, B.Sc.

Tues., 22nd. R.Ae.S. Isle of Wight Branch Lecture: "Future Development of Aircraft Construction," by Dr. Roxbee Cox.

Wed., 23rd. R.U.S.I. Lecture: "Influence of Aircraft on Land Operations," by Sir Arthur Willert, K.B.E.; 3 p.m., Royal United Service Institution.

Fri., 25th. Reading Aero Club: Annual Dance (10 p.m.) and Flying Members' Dinner, Falcon Hotel, Reading.

NOVEMBER (Cont.)

Fri., 25th. Strathtay Aero Club: Annual Ball, Salutation Hotel, Perth.

Fri., 25th-Sun., Dec 11th Paris Aero Show with Air Transport Congress.

Tues., 29th. Institute of Transport: Brancker Memorial Lecture—"Development of Air Mail," by D. O. Lumley, O.B.E.; 6.0 p.m., Institution of Electrical Engineers, Victoria Embankment, London, W.C.2.

DECEMBER.

Thurs., 1st. Herts and Essex Aero Club: Annual Dinner and Dance, Park Lane Hotel, London, W.1.

Thurs., 1st. R.Ae.S. Lecture*: "Flying Controls," by Prof. G. T. R. Hill, M.C., M.Sc., F.R.Ae.S.

Fri., 2nd. Eastbourne Flying Club: Annual Dinner and Dance, Grand Hotel, Eastbourne.

Tues., 6th. R.Ae.S. Isle of Wight Branch Lecture: "Flight Testing," by Capt. Courtney.

Thurs., 8. R.Ae.S. Students' Section: Joint Lecture with I.A.E. Students' Section: "Carburation and Induction in Aircraft Engines," by K. C. Hunt; 12, Hobart Place, London, S.W.1.

Thurs., 15th. R.Ae.S. Lecture*: "Some Results from the Deutsche Forschungsanstalt fur Segelflug Smoke Tunnel," by Herr A. Lippisch, A.F.R.Ae.S.

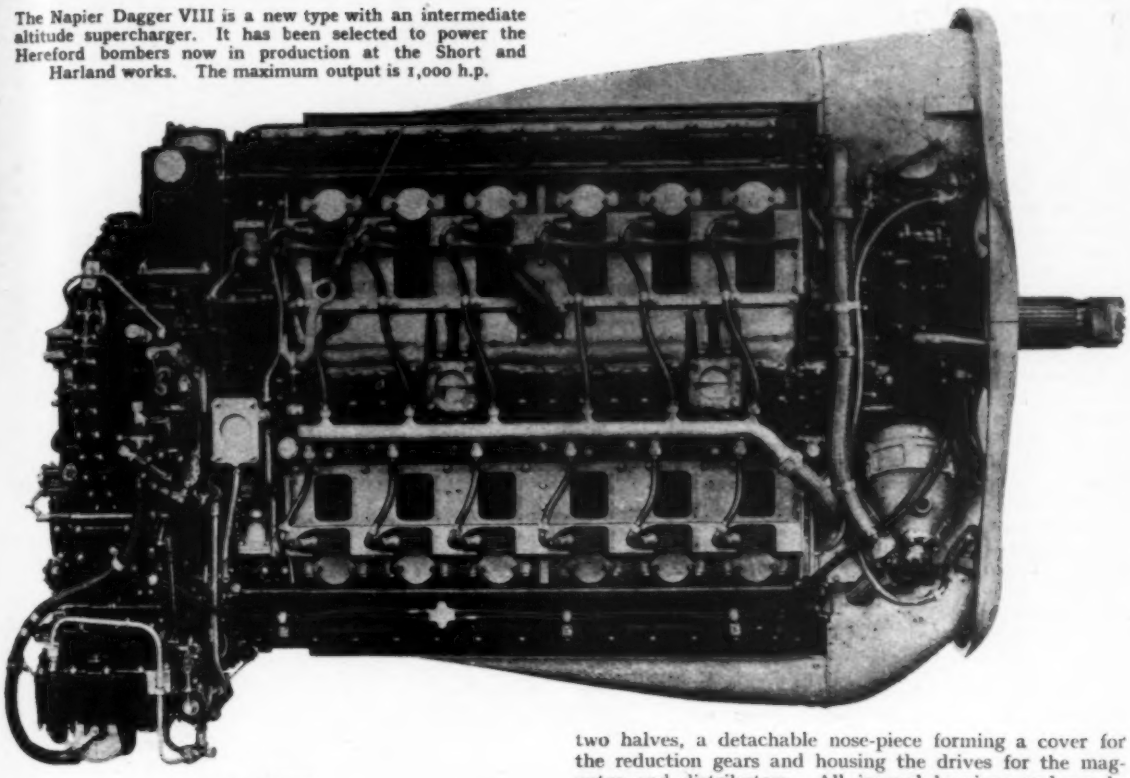
Fri., 16th. D.H. Aeronautical Technical School: Reunion Dinner, London Aeroplane Club, 8 p.m.

Tues., 20. R.Ae.S. Isle of Wight Branch: Debate

Tues., 20. R.Ae.S. Students' Section Lecture†: "The Air Mail Scheme," by Gibson Pattison, F.S.S.

* All these lectures take place at 6.30 p.m., at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.
† All these lectures take place at 7 p.m. in the R.Ae.S. Library, 7, Albemarle Street, London, W.1.

The Napier Dagger VIII is a new type with an intermediate altitude supercharger. It has been selected to power the Hereford bombers now in production at the Short and Harland works. The maximum output is 1,000 h.p.



NAPIER

TWO "milestones" in the development of the Napier Rapier and Dagger series of air-cooled in-line engines of "H" formation have lately been recorded in *Flight*. These are the non-stop flight of *Mercury*, upper component of the Short-Mayo Composite aircraft, to the mouth of the Orange River, South Africa, and the initial flying trials of the Hereford bomber at the Short and Harland works, Belfast. *Mercury* is powered with four Rapier VI engines and the Hereford has two of the new Dagger VIIIs.

The following notes will apply to the Rapier VI, Dagger III and Dagger VIII, although a fully supercharged version of the Rapier—the Series V—is available. Particulars for this model are given in the table on a previous page.

The Rapier VI has sixteen cylinders. Its crankcase is of magnesium alloy and is in two halves. A detachable nose-piece forms a cover for the main reduction gears. There are two crankshafts—one for the two port blocks and one for the two starboard blocks. The cylinders are steel forgings machined all over and have heads of aluminium alloy.

On the port side and driven off a cross shaft at the rear of the engine is a gear-type petrol pump.

Lubrication is by high pressure to crankshaft journals, big ends and gudgeon pins. Reduction gears are lubricated by oil projected on to the teeth from two jets fed by the high-pressure system. Two magnetos are situated at the rear of the engine immediately in front of the supercharger, which unit is of the centrifugal type with an impeller driven from an extension of the airscrew shaft through layshafts by spur gears. Features are a frictionless clutch for protection against sudden changes of speed and an automatic boost-control unit.

The standard power plant of the Hawker Hector army co-operation machine used by the Royal Air Force is the medium supercharged 24-cylinder Dagger III. Like the Rapier, this model operates on fuel of 87 octane number. The dimensions are: Length, 6ft. 8in.; width, 1ft. 11in.; height, 3ft. 9½in.

As in the case of the Rapier VI, the crankcase is in two halves, a detachable nose-piece forming a cover for the reduction gears and housing the drives for the magnetos and distributors. All journal bearings and crankpins for the two crankshafts are hollow. The cylinders are steel forgings machined all over and the heads are of aluminium alloy. Each of the twenty-four pistons has two gas rings, one scraper ring and a hollow gudgeon pin.

The connecting-rod assembly for each crank comprises a forked rod, in which the lead bronze steel bearing shell is fixed, and a plain rod which oscillates on the outside of the bearing shell. The assemblies are arranged in groups of three; the front three starboard and the rear three port plain rods are attached to pistons in the top cylinders and in the other cylinders the positions of the forked and plain rods are reversed. The gudgeon-pin bushes are of phosphor-bronze.

Oil is fed under high pressure to the crankshaft journals, big ends and gudgeon pins, and the reduction gears are lubricated after the fashion of those in the Rapier VI. Oil passes through a reducing valve to form a low-pressure system which lubricates the remainder of the engine. Escaping oil from the various bearings, etc., is drained into the sump and returned to the supply tank by scavenge pumps.

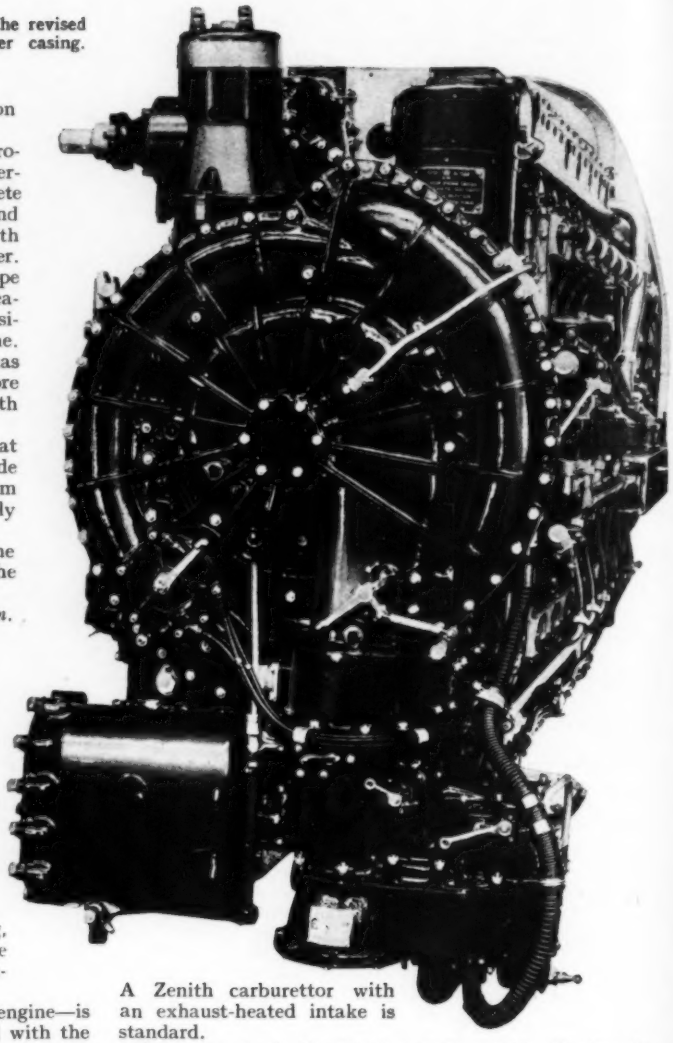
The description of the supercharger for the Rapier VI also applies, in essentials, to that for the Dagger III.

Ignition is by two magnetos with separate 24-point distributors, all driven from the airscrew shaft. The timing of the ignition is advanced with r.p.m. by two automatic advance units, one for each magneto. The whole of the H.T. system is bonded and earthed to eliminate interference when wireless is fitted.

A Rotax inertia starter of the Eclipse type is fitted to operate through bevels upon the rear end of the port crankshaft. Alternatively, an electrically energised inertia starter may be substituted.

A standardised cowling has been developed, complete with air chutes and baffle plates for a tractor installation. A drive is provided in the rear of the engine for a standard R.A.E. spigot-mounted, 500-watt generator.

Formerly known as the Dagger E108, the Napier Dagger Series VIII has passed the British Air Ministry's 100-hour type test. It is not yet permissible to describe in detail the construction of this efficient power plant, but the latest figures are given in the table on a previous



A rear view of the Napier Dagger VIII showing the revised arrangement of accessories and the supercharger casing.

page. These apply to the engine as operated on fuel of 87 octane number.

Several design improvements have been introduced, such as a larger double-entry supercharger, increased cooling fin area, complete ignition screening, provision for a De Havilland constant-speed airscrew, S.U. carburettor with automatic mixture control and an electric starter. Nose cowl and air chutes of standardised type are now included with each engine. This feature relieves the aircraft designer of the responsibility of arranging for the cooling of the engine.

Drastic rearrangement of accessories has enabled the engine to be presented in a more compact form and some 7in. in overall length have been saved.

As the engine gives its maximum power at 8,750ft. it is known as an intermediate altitude type, being rated at a greater height than medium supercharged engines and rather lower than fully supercharged models.

A notable feature in comparison with the earlier Dagger III is the raising of the line of the airscrew shaft.

MAKERS: *D. Napier and Sons, Ltd., Acton, London, W.3.*

POBJOY

BEST known of the Pobjoy models, the Niagara III is a seven-cylinder air-cooled radial of 2,835 litres capacity and with a rated output of 88 h.p. at 3,300 r.p.m.

The cylinders have steel barrels screwed into die-cast aluminium heads. Pistons are of the duralumin slipper type with two compression and one scraper ring. The crankcase is in four sections; all the castings are of aluminium alloy. Valve gear is completely enclosed in oil-tight cast aluminium casings.

A feature of special interest is the cowling, which is supplied as an integral part of the engine and which ensures efficient cooling without interfering with accessibility.

The Niagara V—a later and more powerful engine—is remarkable for its increased output as compared with the Niagara III. Although of approximately the same size and weight as the earlier type the continuous cruising power is rather better than the maximum output of the Series III engine.

Photographs of the latest Niagara V are not available, but it may be said that the engine has been entirely redesigned by Mr. Towler and that in its present form it differs very considerably from that evolved last year by Mr. Pobjoy.

The new Niagara V will not be put on the market until it has undergone several hundreds of hours of intensive test work on the bench and in the air.

Apart from the Niagara V data published in the table on p 390, the following figures may be of interest: Fuel consumption at maximum power, 9.5 gal/hr.; fuel consumption at economical cruising output (90 h.p.), 5.4 gal./hr.; oil consumption, 1 to 2 pt./hr.

MAKERS: *Pobjoy Airmotors and Aircraft, Ltd., Rochester, Kent.*

J.A.P.

PRIMARILY for use in machines manufactured by the Aeronautical Corporation of Great Britain, Ltd., J. A. Prestwich and Co., Ltd., are building a horizontally opposed twin with a normal output of 34 h.p. at 2,400 r.p.m. The big ends and main bearings have ball and roller races and the rockers for the two valves in each head run on rollers.

Oil is taken from a separate finned portion of the crankcase by a double-gear type scavenging and pressure pump

A Zenith carburettor with an exhaust-heated intake is standard.

MAKERS: *J. A. Prestwich and Co., Ltd., Northumberland Park, Tottenham, London, N.17.*

ROLLS-ROYCE

ALTHOUGH the Kestrel series is still in demand (and has, in fact, been developed to a very high pitch) the name of Rolls-Royce is now chiefly associated with the larger and more powerful Merlin which is installed in some of our most efficient fighting and bombing aircraft.

The Merlin is a geared twelve-cylinder vee type with a capacity of 27 litres, which is 27 per cent. greater than that of the Kestrel series.

Up to the moment the majority of Merlins produced have been of the fully supercharged type—chiefly Merlin IIs—but more recently a new model with a two-speed supercharger (Merlin X) has been evolved and will be installed in the latest type of Armstrong Whitworth Whitley bomber. There is also the Merlin VIII with a medium-altitude supercharger, but figures for this type are not yet available.

The Merlin III, now being introduced into the R.A.F. in succession to the Merlins I and II, is actually the same engine as the Merlin II, but embodies a standardised airscrew shaft to take either the De Havilland or Rotol variable-pitch airscrews. Another modification is the provision of a dual drive for accessories at the front end. The Merlin IV is also virtually the same engine but, apart from the modifications incorporated in the Merlin III, it is cooled by water under pressure instead of by Glycol. This has the effect of raising the boiling point of the water

BRITAIN'S AERO ENGINES (CONTINUED)

well above a 100 deg. C. and should avoid the difficulties of draining and supplying the Glycol.

In all essentials the following description of the Merlin will apply to all current models, excepting the Merlin I.

The crankcase is an aluminium casting made in two halves bolted together. The upper half is cast integral with the rear half of the reduction gear casing and carries the cylinder blocks in addition to incorporating the seven main bearings and caps, the engine mounting feet, slinging points, etc. In the lower half are the oil pumps and filters together with drives for a hydraulic undercarriage pump or low-pressure air compressor. At the rear end of both halves is a vertical facing for mounting the wheel case which houses the auxiliary drives.

The main bearings are split mild steel shells lined with lead-bronze and fitted into recesses machined in the crankcase. They are held in position by caps and bolts passing through the caps and across the whole width of the crankcase.

A one-piece forging, the crankshaft has integral balance weights. It is machined all over, nitrogen-hardened, and its crank pins and journals are bored and fitted with oil retaining covers. Oil is fed into the journals and passes through drilled passages into the crankpins to feed the big-end bearings.

The drive to the reduction gear pinion is taken from a flange bolted to the front end, and the spring drive to the camshafts, supercharger and all auxiliaries from the rear end.

There are two connecting rods to each crankpin. These are of "H" section, and are nickel-steel forgings machined all over, each pair consisting of a plain rod and a forked rod carrying a nickel-steel bearing block lined inside and out with a special lead-bronze mixture. The bearing block is divided across its bore, and bears directly on the crankpin being secured to the forked rod by four bolts, whilst its outer lining forms the bearing for the plain rod. Lubrication of the big-end bearings is by pressure feed from the crankpins, but the small end bush relies upon the oil mist from the cylinder walls and pistons. The forged aluminium alloy pistons are machined all over, and are fitted with three gas and two scraper rings. The hollow gudgeon pins are of the fully floating type, and are retained in position by spring circlips.

Each of the two banks of cylinders, which are set in a vee at an angle of 60 deg. on the upper half of the crankcase, is a monobloc aluminium casting with integral heads and water jackets into which are inserted six "wet" cylinder liners of high carbon steel.

The cylinder head houses the valves, camshaft and rocker gear. At the upper end of each liner is a spigoted flange registering in a recess in the head, a soft aluminium alloy joint ring ensuring gas tightness, while the coolant joint at the base of each cylinder is made by a rubber ring, spring-loaded in an external groove in the liner. The lower end of the liner is flanged for seating on the crankcase. Fourteen long studs extending from the top of the block castings into the crankcase secure the cylinder assembly in position and maintain the gas tightness of the head joint. Relative movement between the cylinder skirts and the liners is permitted by the spring-loaded glands, which at the same time ensure coolant-tight joints.

A certain degree of flexibility and a reduction in local distortion of each top joint face under sudden temperature changes are allowed by a lateral saw-cut between each combustion head. Further, to improve this joint and prevent disturbance of the liner during removal of the cylinder block there are six additional studs on each side of the block to secure clamps. These studs abut against the lower face of the top flange of each liner.

Renewable valve seatings (aluminium bronze for the inlet and silchrome for the exhaust) are screwed into the cylinder heads which also house the cast-iron inlet, and the phosphor bronze exhaust-valve guides. The camshafts, which are driven through the spring drive by an inclined shaft and bevel gears from the wheel case at the rear of the engine, are nickel steel forgings machined all over and case-hardened and ground on the cam and bearing surfaces.

Each valve is operated by a separate steel rocker having a spherical-headed tappet screw and locknut at the valve end for tappet adjustment.

There are four valves—two inlet and two exhaust—for each cylinder, all working parallel to the axis of the cylinder. Each is fitted with two concentric-coil springs.

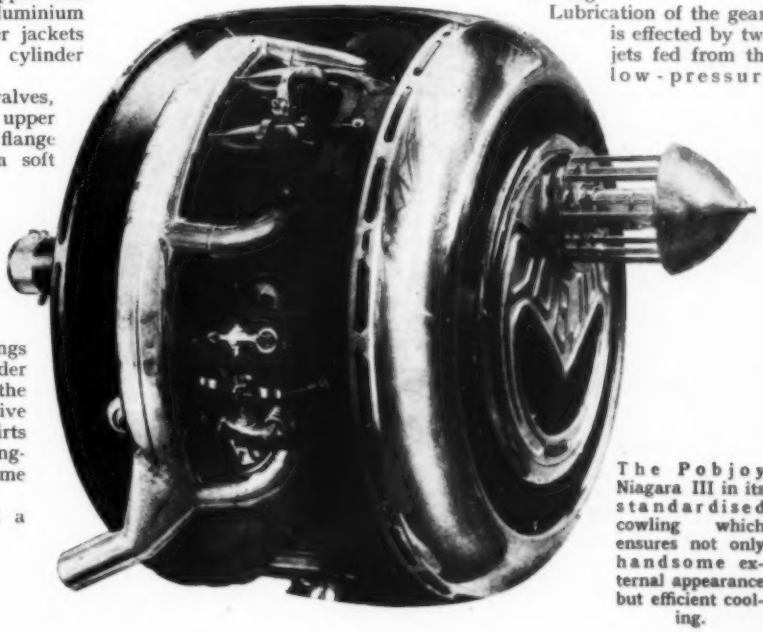
To damp out irregularities in angular velocity and torque, the drive from the crankshaft to the supercharger, timing gears, and auxiliary components, is taken through a torsionally flexible shaft which provides a spring drive. The twisting of this shaft is limited by a hollow sleeve connected to its outer end by means of a damper clutch, the drive then being taken up by the sleeve.

The wheel-case—an aluminium alloy casting—houses, apart from the supercharger unit on its rear face, the drives to the camshafts, magnetos, coolant and oil pumps, fuel pumps, supercharger, hand and electric starters and electric generator.

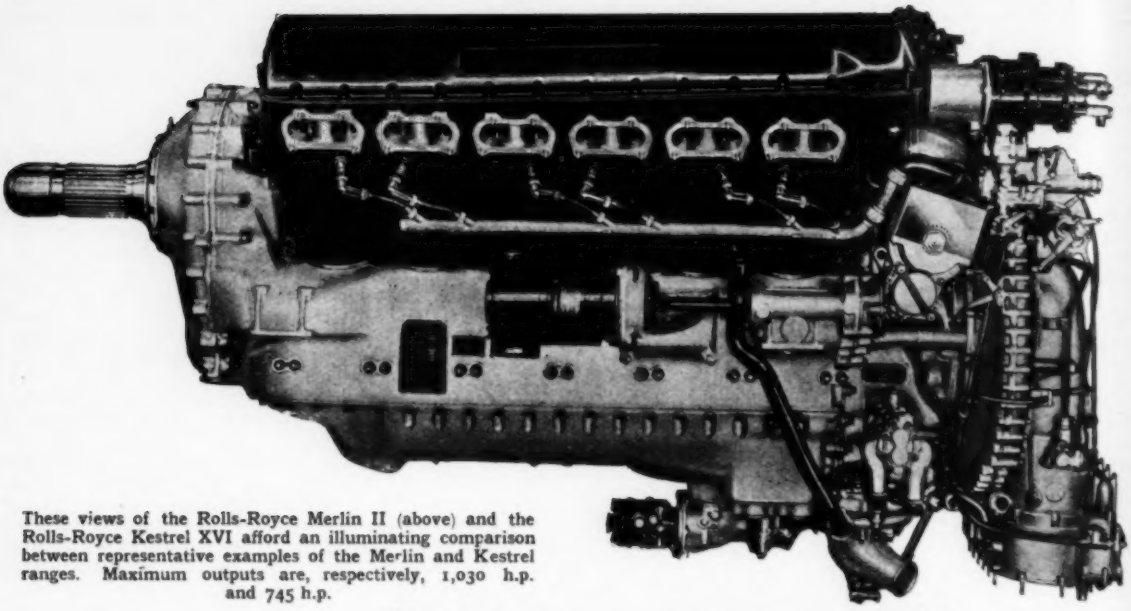
Alternative methods of starting are by an electric starter motor or an auxiliary hand-turning gear.

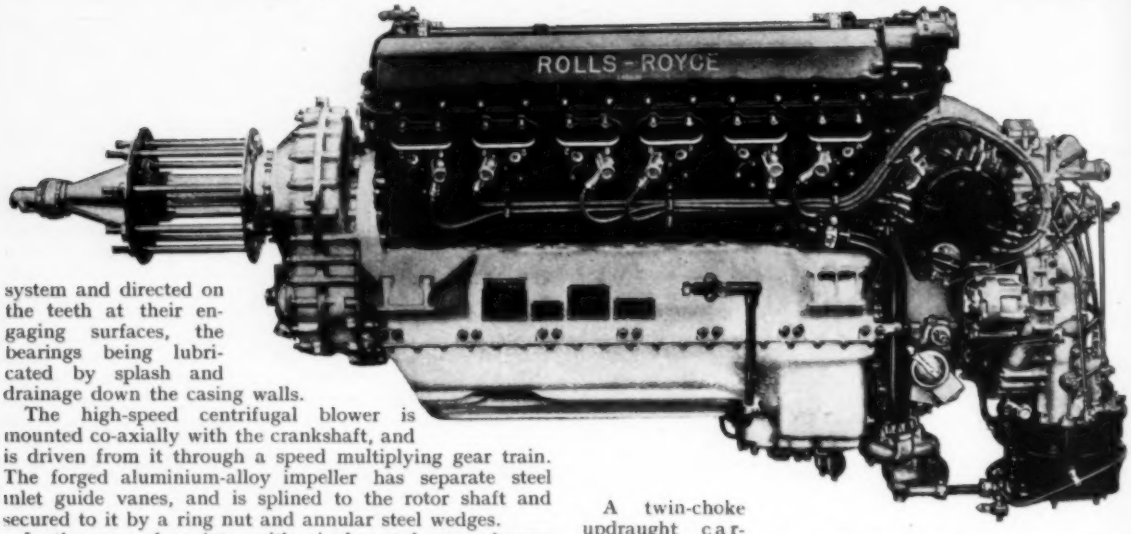
A single spur reduction gear is used. The pinion, which is hollow and carried in two roller bearings, is coaxial with, and driven from, the crankshaft by a short hollow shaft, serrated at both ends, engaging the crankshaft flange and the forward end of the pinion internally. This pinion engages with a toothed ring bolted to a flange formed integral with the hollow airscrew shaft, the latter being supported on roller bearings and fitted with a ball bearing which takes axial thrust in either direction. The hollow-drive shaft isolates the pinion bearings from the crankshaft loading.

Lubrication of the gears is effected by two jets fed from the low-pressure



The Pobjoy Niagara III in its standardised cowling which ensures not only handsome external appearance but efficient cooling.





These views of the Rolls-Royce Merlin II (above) and the Rolls-Royce Kestrel XVI afford an illuminating comparison between representative examples of the Merlin and Kestrel ranges. Maximum outputs are, respectively, 1,030 h.p. and 745 h.p.

system and directed on the teeth at their engaging surfaces, the bearings being lubricated by splash and drainage down the casing walls.

The high-speed centrifugal blower is mounted co-axially with the crankshaft, and is driven from it through a speed multiplying gear train. The forged aluminium-alloy impeller has separate steel inlet guide vanes, and is splined to the rotor shaft and secured to it by a ring nut and annular steel wedges.

In the case of engines with single-speed supercharger drive the speed-multiplying train comprises a system of planets driven from a gear on the crankshaft by slippers which are held in engagement with the insides of the gear rims by light springs. The radial pressure of these springs is augmented by centrifugal force as the rotational speed increases, and consequently the torque which the planets can transmit increases as the square of the speed. The torque required to drive the impeller increases at a like rate, and therefore the gear is capable of driving the impeller with a predetermined margin of torque above that causing slip, which torque is constant throughout the speed range. This special friction drive not only equalises the loading on the gear teeth, but also serves to protect the gearing against damage due to the impeller inertia under sudden accelerations or decelerations. In the case of the Merlin II engine the ratio of impeller speed to crankshaft speed is 8.588 to 1.

In the case of the two-speed supercharger the change-speed gear is operated by oil pressure from the scavenge system, and the time occupied in changing gear (when running under full-power conditions) is of the order of one second.

Supercharger delivery pressure is controlled by an automatic servo mechanism working through a differential linkage to limit the throttle opening and to protect the engine from any damage resulting from over-boosting.

A twin-choke updraught carburetter of Rolls-Royce S.U. design is fitted, the two air passages being coupled by a single Rolls-Royce type of forward-facing air intake which bolts on to a flange at the base of the carburetter.

Lubrication is on the dry sump principle, there being one pressure pump and two scavenge pumps, the latter working in parallel to drain, independently, the front and rear sumps in the lower half crankcase.

Accessories include a 12-volt, 500-watt generator, a revolution counter-drive connection, drives for low-pressure and high-pressure air compressor, a Lockheed undercarriage pump, constant speed airscrew unit, instrument vacuum pump, and if need be, a gun-turret pump.

Space does not permit a full description of the Kestrel engines, but data, together with those for the Merlins, are given in the table on a previous page.

MAKERS: *Rolls-Royce, Ltd., 14-15, Conduit Street, London, W.1.*

SCOTT

PREOCCUPATION on defence work has resulted in postponement of development work on the Scott two-cylinder engine for light aircraft, although one or two enthusiasts are using this unit with satisfaction.

MAKERS: *The Scott Engineering Co., Shipley, Yorks.*

The ANCILLARY INDUSTRY

In the tool and gauge shops of Cornercroft, Ltd. (Para. 17).

An Easy-Reference Encyclopædia of Over 400 Firms that Make Their Contribution to British Aircraft Manufacture and Operation

1 A.B.C. MOTORS, LTD., Walton-on-Thames (Walton-on-Thames 774/5).—Designers and manufacturers of internal-combustion engines; auxiliary power units for generating, pumping, and air compressing; aeronautical and precision engineers, and approved contractors to the Admiralty, War Office and Air Ministry.

2 PLASTILUME PRODUCTS LTD., Station Works, High Wycombe (High Wycombe, 1610/1).—Designers and manufacturers of windscreens, cabins, wing strut and tail fairings, fin fairings, wheel spats, trousers, navigation and landing light windows, in I.C.I. "Perspex" (synthetic resin) or acetate sheeting such as "Novellon," etc., to Air Ministry specification.

3 ENGLISH STEEL CORPORATION, LTD., Vickers Works, Sheffield (Sheffield 41071).—Special alloy steels and drop forgings (as used in all record flights by British machines); aero engine parts and fittings; precision-ground bar (round and hexagon); engineers' small tools, files and hacksaws.

4 RANSOMES AND RAPIER, LTD., Ipswich and London (Ipswich 2143/6).—Rapier mobile cranes with rubber-tyred road wheels (solids or pneumatics)—petrol electric or diesel electric—for aerodrome and shed service; Rapier slider catapults, developed from design patented by the British Admiralty and suitable for use ashore or afloat; Rapier Glover aircraft docking cradles for handling all types of boat and float seaplanes on slipways, floating docks and hangars.

5 BRUNTONS, LTD., Musselburgh, Scotland (Musselburgh 28).—Streamline wires; tie rods; "Beacon" Trulay cables and fittings for aircraft, to A.M. and B.S. specifications; steel wire; cold-rolled strip in mild, carbon, pen and stainless steel; wire rope; cold-drawn finished steels and shafting in rounds, squares, hexagons and flats; special-section steels, stainless steels; turbine blading; carbon, high-speed and stainless-steel drill rods; manufacturers of Haigh alternating stress-testing machine for fatigue testing of metals, and Haigh-Robertson fatigue-testing machine for wire.

HOW to USE THIS GUIDE

AN index to the type of product manufactured or supplied will be found in the "Products" section of the index at the end of this review. The numbers given in the index refer to the paragraphs dealing with the appropriate firms. If direct reference to a particular firm is required, the paragraph number can be ascertained from the "Firms" section of the index.

While it is not possible to index every item in the case of firms with many different "lines," efforts have been made to render the index as comprehensive as space permits.

Companies coming entirely within certain other categories of the aircraft industry, e.g., airline operators, are dealt with in the appropriate special numbers of "Flight" published on other occasions. Complete aircraft were reviewed in last week's special issue.

6 PERRY BARR METAL CO., LTD., Perry Barr and Handsworth, Birmingham (Northern 3366-7).—Aluminium alloy die castings; aluminium alloy machined components; Alclad and Duralumin pressings; sheet metal work; aircraft assemblies.

7 HERBERT TERRY AND SONS, LTD., Redditch, Worcs (Redditch 61).—Springs; pressswork and wirework manufacturers; valve springs; flexible shaft; spring washers; hose clips; tools clips; flat steel spanners in B.A., Whitworth and Metric sizes; "Anglepoise" adjustable lamps; taper pins; split pins; parallel pins; spring belt in all sizes; waterproof cable sheathing.

8 LAYCOCK ENGINEERING CO., LTD., Victoria Works, Millhouses, Sheffield, 8 (Beauchief 70041).—Precision machining; assembling and finishing of engine and aircraft components and sub-assemblies; drop stampings; approved firm A.M. Form 705 and A.N.D. 13.

9 THOS. FIRTH AND JOHN BROWN, LTD., Atlas Works, Sheffield (Sheffield 20081).—Manufacturers of steels for aero engine and airframe construction, supplied in bars, billets, sheets, forgings, etc.; manufacturers of tools for aircraft production; "Speedicut" high-speed steel drills; carbide-tipped tools; "Millenicut" files; "Insto" inserted-tooth cold saws; fixed- and variable-load hardness-testing machines; drill point grinding machines.

10 JOSHUA BIGWOOD AND SON, LTD., Wolverhampton (Wolverhampton 20686).—Incorporating The International Unicalor Co.; manufacturers of rolling-mill equipment for sheet, bar and tube mills; bending, straightening and forming machines for aircraft materials; manufacturers of underfeed automatic coal stokers and heating stoves.

11 NORTHERN AIRCRAFT AND ENGINEERING PRODUCTS, LTD., Guide Bridge Mill, Ashton-under-Lyne, Lancs (Ashton 2806/7).—Manufacturers of

Zipp-fastened flying suit, with helmet and goggles, by D. Lewis, Ltd. (Para. 273).

all types of aircraft components, including wings, tail planes, rudders, elevators, tanks, seats, cowlings; pressings; welding; anodic plating.

12 THE SPERRY GYROSCOPE CO., LTD., Great West Road, Brentford, Middlesex (Ealing 6771).—Manufacturers of Gyropilots for civil and military aircraft (as fitted to the new fleets of Imperial Airways, British Airways and most Continental airlines) and of the Sperry Directional Gyro and Gyro Horizon (as standardised for commercial and military aircraft throughout the world).

13 THE PHOSPHOR BRONZE CO., LTD., 54, St. Thomas Street, London, S.E.1 (Hop 0703/6).—All kinds of bronzes, with "Cog Wheel" brand phosphor bronze as the leading alloy; extensive range of white anti-friction metals, with "Vulcan" A1 and "Ibis" Copper-hardened, as used in aeroplane engines; non-ferrous alloys to all standard specifications.

14 THE Y.S.C., LTD., (HOLTS PATENTS), Thavies Inn, London, E.C.1 (Works, London and Sheffield) (Central 8810, and Works, New Cross 0319).—Holt flares and brackets; "Very" signal cartridges; friction rockets; smoke signals; general pyrotechnics; mechanical engineering.

15 AUSTER, LTD., Crown Works, Barford Street, Birmingham, 5 (Mid. 2123).—Windscreens; sliding, fixed and hinged windows and lights; fabricated components; airscrew, gun and engine covers; hoods; tilts; radiator muffs.

16 DAVID MOSELEY AND SONS, LTD., Ardwick, Manchester, 12 (Ardwick 3341).—"Float-on-Air" pneumatic seating and seat-cum-lifebelts for aircraft; all types of rubber products for aircraft work, including engine mounting blocks, strip, mouldings, sparking plug covers and washers; petrol, oil-resisting and oxygen-breathing tubing.

17 CORNERCROFT, LIMITED, Ace Works, Queen Victoria Road, Coventry (Coventry 4123), (London: 18, St. George Street, Hanover Square, W.1).—Manufacturers of aircraft components; specialists in aero engine cowling and cowling components; press work of all kinds for the aircraft industry; jigs, tools, fixtures and gauges for the aircraft, motor and allied trades; specialists in spar assembly and other large aircraft jigs.

18 FIELDING AND PLATT, LTD., Atlas Works, Gloucester (Gloucester 2158).—Hydraulic machinery of all kinds, including high-speed presses with self-contained pumps, automatic and semi-automatic type, for sheet metal working; hydraulic extrusion presses for tubes and solids, etc.

19 SAMUEL FOX AND CO., LTD., Stocksbridge Works, Near Sheffield (Sheffield 40871).—Siemens and electric alloy and special steels to all B.S.I. and D.T.D. specifications in billets, bars, sheets, strip and wire, with Diamet inspection applied where requirements are particularly stringent.

20 ARTHUR L. GIBSON AND CO., LTD., Twickenham (Popesgrove 2276-2277).—Kinnear patent steel rolling shutters for hangars, stores buildings, garages, etc.; Kinnear patent rolling grilles for transformer stations, etc.; Kinex expansion bolts.

21 F. A. HUGHES AND CO., LTD., Abbey House, Baker Street, London, N.W.1 (Welbeck 2332).—Suppliers of "Elektron" magnesium-rich alloys to Air Ministry specifications; pure magnesium; magnesium powder; "Autogal" welding fluxes for aluminium alloys.

22 MAGNESIUM ELEKTRON, LTD., Clifton Junction, Near Manchester (Head Office, Abbey House, Baker Street, London, N.W.1).—Sole producers of "Elektron" magnesium-rich alloys in England. (See also F. A. Hughes and Co., Ltd.—above.)

23 HEY ENGINEERING CO., LTD., Lythall's Lane, Coventry (Coventry 8641).—Special machine tool designers for aero engine and airframe manufacture; jig and fixture designers and manufacturers; multiple-spindle drill heads for aircraft industry; planning, processing and designing for manufacture of component aircraft parts.

24 RELIANCE SHEET-METAL WORKS, LTD., Mile Lane, Coventry (Coventry 4906).—Sheet-metal work, pressings and press tools for the aircraft, motor and general trades; oxy-acetylene and electric welding.

25 A. W. FABER, 13/14, Camomile Street, London, E.C.3 (Avenue 1347).—Precision slide rules; scales; rulers; "Castell" pencils and "Polychromos" coloured pencils; "Castell" erasers; mathematical instruments.

26 EQUIPMENT AND ENGINEERING CO., LTD., 2/3, Norfolk Street, Strand, London, W.C.2 (Temple Bar 1088).—"E & E" Magnaflux crack detector for the testing by magnetic means of iron or steel for cracks or flaws caused or developed due to overstrain, fatigue or shock.

Combined aircraft radiator and oil cooler—Serck Radiators, Ltd. (Para 235).

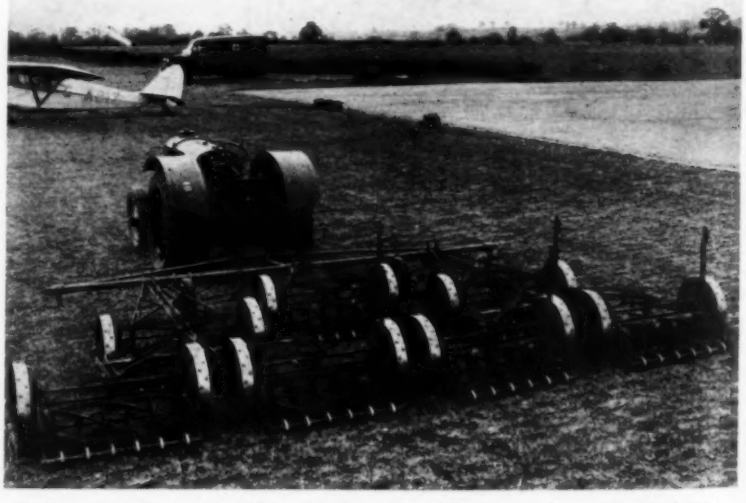
27 JAMES WALKER AND CO., LTD., Lion Works, Woking (Woking 2255). London Office: 96-8, Leadenhall Street, E.C.3 (Avenue 1150).—Specialists in the design and manufacture of packings and jointings for aircraft engines and components; "Lion" water pump gland rings; Golden "Walkerite" compressed asbestos jointing; "Gaskoid" oil and spirit jointing, "Copandas" metal-sheathed joints, "Petso" oil and petrol packing rings.

28 BONEHAM AND TURNER, LTD., Nottingham Road, Mansfield, Notts (Mansfield 896).—Manufacturers of small machined parts; repetition work; hardening and grinding; jigs and fixtures; light stampings.

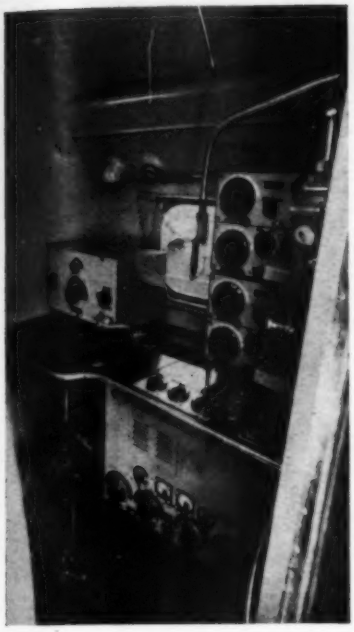
29 SILENT GLIDING DOORS, LTD., 38, Ingate Place, London, S.W.8 (Macaulay 1011).—"Aerodoor" doors for all sizes of aircraft hangars, constructed of cold-rolled steel hollow mullions forming a chain to slide back (manually or electrically) against interior wall.

30 AIRSCREW CO., LTD., Weybridge, Surrey (Weybridge 1600/2).—Designers and manufacturers of wooden fixed pitch airscrews; blades for all types of v.p. airscrews; high-strength compressed and impregnated wood; fans for ventilating and cooling purposes; approved by Air Ministry and Air Registration Boards.

31 BIRMINGHAM TOOL AND GAUGE CO., LTD., Soho Hill, Handsworth, Birmingham, 19 (Northern 3344/5).—Manufacturers of milling cutters, reamers (both special and standard) and gauges; precision component machining; precision bench milling machines, precision arbor presses; Mid-



A Ransome, Sims and Jefferies (Para. 136) "Magna-gang" mower at Oxford Airport.



Marconi radio in a British Airways Lockheed Electra. On the left is the short-wave receiver, and on the right the medium-wave and D/F. receiver, with remote control for the external loop. (Para. 68.)

land agents for Zeiss metallurgical microscopes.

32 AMAL, LTD., Holford Works, Birmingham, 20 (Birchfield 4571).—Manufacturers of flowmeters, jet-calibrating machines, fuel pumps, pressure-regulating valves, non-return valves, flame traps, thermometer oil pockets, filters, control joints, cowling fasteners; on Air Ministry list of approved firms; Associate Members of the S.B.A.C.

33 CRODA, LTD., Rawcliffe Bridge, Goole, Yorks (Rawcliffe 40-41).—Lanoline rust preventive D.T.D. 121 C; Lanoline D.T.D. 122 B; commercial rust preventives for all uses; "Crodol" and "Oliv-Lan" anti-dermatitis ointments for protecting skin against oils, spirits, dopes, etc.

34 HARVEY FROST AND COMPANY, LTD., Dunmow Road, Bishop's Stortford, Herts (Bishop's Stortford 700).—Tyre-servicing equipment.

35 ERNEST LAKE, LTD., Dunmow road, Bishop's Stortford, Herts (Bishop's Stortford 700).—Aircraft equipment, including engine stands (in-line and radial), jacking trestles, fuselage trestles, tail trestles, manœuvring skates.

36 ALDIS BROTHERS, LTD., Sarehole Road, Hall Green, Birmingham, 28 (Springfield 1325, 1590).—All optical sighting devices for aircraft, including signalling lamps, camera aiming sights and machine gun sights.

37 W. CANNING AND CO., LTD., Great Hampton Street, Birmingham, 18 (Central 8621).—Plants for processes of corrosion prevention in aircraft; for cadmium-plating iron and steel components; for anodic oxidation of aluminium; for nickel-plating for exhaust manifolds, outsides of air-cooled cylinders, and for building up deposits; for hard-chrome plating, as protection against abrasion and for parts subject to wear, such as the skirts of cylinder liners; for chromating magnesium and Elektron parts to inhibit corrosion.

38 B.E.N. PATENTS, LTD., Gorst Road, Park Royal, London, N.W.10 (Willesden 2066).—Spraying machines and equipment for the application of dopes, paints, varnishes, synthetic enamels, etc.; air-compressors for tyre inflators and the operation of air tools; garage-servicing equipment.

39 RUBERY OWEN AND CO., LTD., Darlaston, South Staffs (Darlaston 130).—P.B.X. aircraft components, turnbuckles, eyebolts, bolts, nuts, screws, etc.; turned parts of every description in stainless, high-tensile and other steels; pressings in stainless, Alclad, aluminium and duralumin; sheet metal work.

40 STERLING METALS, LTD., Northey Road, Coventry (Coventry 8035).—Manufacturers of castings for the aircraft industry; sand and gravity die castings and forgings for aircraft engines, airframes, etc., in aluminium and "Elektron" magnesium alloys.

41 THOS. SINTON AND CO., LTD., Laurel Vale, Tandragee, Northern Ireland.—Manufacturers of aeroplane linens to government and other specifications. Selling agents: J. W. Gates and Co., Swan House, 133, Oxford Street, London, W.1 (Gerrard 3164).

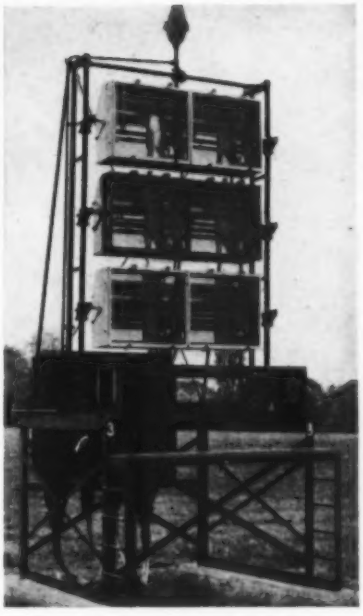
42 THE S.U. CARBURETTER CO., LTD., Adderley Park, Birmingham, 8 (Birmingham East 1171).—Aero automatic carburetters and automatic variable datum boost controls. Carburetters, as fitted to Rolls-Royce Merlin, De Havilland Gipsy-king and Napier Dagger VIII, to suit engines from 50 to 2,500 h.p.; special requirements designed and manufactured to order at short notice.

43 THE HOFFMANN MANUFACTURING CO., LTD., Chelmsford, Essex (Chelmsford 3151).—Ball and roller bearings; steel balls and rollers; special ranges of bearings for aircraft controls, gyros, etc.

44 WOODASON AIRCRAFT MODELS, Heston Airport, Hounslow (Hounslow 2345).—Scale-model aircraft of any type to order; replica models for the private owner; exhibition models; sectional models for airline companies; secret types for aircraft manufacturers for submitting with designs of new types to A.M. specifications; on Air Ministry approved list.

45 METALASTIK, LIMITED, Evington Valley Road, Leicester (Leicester 24531).—Patentees and manufacturers of bonded rubber to ferrous and non-ferrous metal components for the elimination of vibration and noise from aircraft, vehicles, and machinery. Sole manufacturing rights in Great Britain of the Metalastik crankshaft dynamic balancer, floating power engine mountings and Wireflex seat cushions and squabs.

46 WESTERN PRODUCTS CO., LTD., 198, Buchanan Street, Glasgow (Douglas 4968).—"Duravista" glass skin, permanent anti-steaming agent for windows.



G.E.C. 6kW., six-lamp aerodrome floodlight—one of eight at Croydon. (Para. 57.)

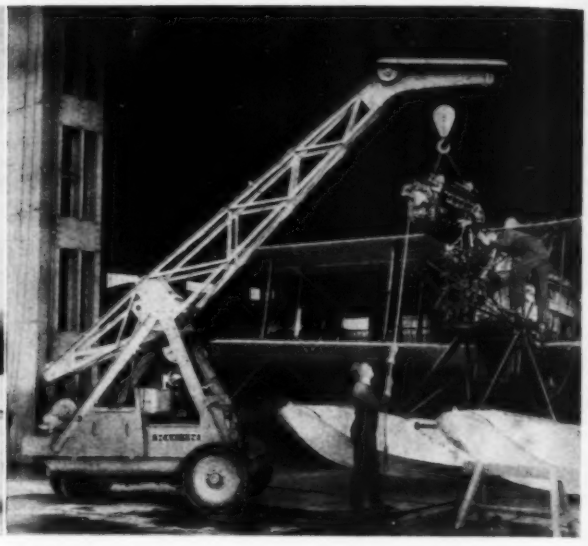
47 BIRMETALS, LIMITED, Woodgate, Quinton, Birmingham (Woodgate 2247).—Manufacturers of normal and coated aluminium sheets, extruded and drawn sections, bars, tubes, and wire, in the high tensile and corrosion-resisting aluminium alloys; also a comprehensive range in the wrought "Elektron" magnesium alloys.

48 DOCKER BROTHERS, Rotton Park Street, Ladywood, Birmingham, 16 (Edgbaston 3511).—Manufacturers of dopes, lacquers, paints and varnishes to Air Ministry and British Electrical Association specifications; also manufacturers of all types of commercial paints, varnishes and lacquers.

49 NEGRETTI AND ZAMBRA, 38, Holborn Viaduct, London, E.C.1 (Holborn 1972). (Works, Barnsbury, London).—Aircraft instruments to latest Air Ministry specifications; air temperature thermometers; boost gauges; diaphragms of reinforced steel; fuel and oil pressure gauges; oil temperature and radiator thermometers; precision altimeters; wind recorders and other meteorological instruments.

Beauty in metal—aircraft spinnings by the London Aluminium Co., Ltd. (Para. 357.)

A Rotol (Para. 214) constant-speed airscrew, hydraulic type, on the Bristol Pegasus XXII of a Vickers Wellesley.



Mobility in lifting : A Ransome and Rapier aircraft servicing crane (Para. 4.)

50 H. M. HOBSON (AIRCRAFT AND MOTOR) COMPONENTS, LTD., 47-55, The Vale, Acton, London, W.3 (Shepherds Bush 3321).—Claudel-Hobson carburetters; Hobson master control carburetters; automatic mixture controls (Hobson-Penn); variable datum and 3-phase boost controls; cockpit engine controls; electric ice-warning units; compressed-air-operated fuel pumps; pressure and depression gauges for engine test beds.

51 NASH AIRCRAFT SALES AND HIRE, LIMITED, Airport of London, Croydon (Croydon 6484 (day), Wallington 3764 (night)).—Aircraft consultants; dealers in all types of new and used aircraft and aerodrome equipment; specialists in engine spares and instruments; aircraft part exchange and hire purchase.

52 A. AND A. J. LAW, LTD., Runnymede Steelworks, Merton Abbey, S.W.19 (Liberty 3300).—Steel-framed hangars; administration blocks; control towers; workshops.

53 ALEXANDER SHANKS AND SON, LTD., 66, Victoria Street, London, S.W.1 (Victoria 1011).—Gang mowers with special cutting cylinders for maintaining grass landing grounds; motor and hand mowers of all kinds; oil engines; malleable castings.

54 STANDARD TELEPHONES AND CABLES, LIMITED, New Southgate (Enterprise 1234).—Radio installations for aircraft and ground services in temperate or tropical climates: *Civil*.—High and low power equipments for light planes and airliners, direction finders, radio compasses and blind approach receivers; ground stations with "spot" or "variable" wavelength selection and telephone/telegraph service; radio beacons, Lorenz blind-approach installations; Standard-Adcock direction finders; remote control systems. *Military*.—Equipments for fighter, reconnaissance and bomber aircraft; ground stations, including transportable and mobile units.

55 FELCO HOISTS, LTD., 17, Victoria Street, London, S.W.1 (Abbey 7419).—"Felco" short-headroom, lightweight triple-gear chain blocks; short-headroom travelling chain blocks; self-sustaining "Ropelock" hoists; overhead travelling trolleys; overhead runways various types of joist and chain slings.

56 WEATHERSHIELDS, LTD., 151-163, Bishop Street, Birmingham (Mid 4688).—Manufacturers of sliding roofs, sliding doors and hatches; sheet-metal work, presswork; welding (arc, spot and acetylene); tube manipulation sections in all metals; special metal containers; side screens, hoods and tilt covers; seat fittings; upholstery; cabin superstructures; motor transport lorries; steel or wood units.

57 THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2 (Temple Bar 8000).—G.E.C. aerodrome and factory lighting equipment, including floodlights, neon beacons, landing lights, boundary and obstruction lights, Osira mercury vapour electric discharge and Osram filament lamps for all purposes, and lighting control equipment for every section of the industry.

58 A.C. SPHINX SPARKING PLUG CO., LTD., Dunstable, Bedfordshire (Dunstable 360).—"AC" sparking plugs for aero engines; fuel gauges; rev. counters; air intake cleaners and flame arrestors; oil filters; diaphragm-type fuel pumps; radiator thermostats; oil-pressure indicators and switches; A.G.S. parts; small presswork.

59 F. H. OCKENFELS, Mill Street, Slough, Bucks (Slough 1030).—Merchant for small tools and engineers' equipment; sole distributor in the U.K. for "Procedo" rotating lathe centres, "Universal" spring pack tool holder, "Greif" grinding attachment and industrial dust extractor, "Bock" rotary files and milling tools, "Frommia" circular saws, band saws, belt and disc polishing machines, "Olo" dial indicators, "Pylon" lathe chucks, flexible shaft grinders.

60 HOOPER AND CO., (COACHBUILDERS), LTD., 54, St. James's Street, London, S.W.1 (Regent 3242); Coachbuilding and Aircraft Works, Western Avenue, Acton, London, W.3 (Acorn 0137 and 0019).—Manufacturers of aircraft parts and accessories in both wood and metal. Manufacturers of complete units, such as wings, rudders, fins, flaps, etc.

61 EDGAR ALLEN AND CO., LTD., Imperial Steel Works, Sheffield, 9 (Sheffield 41054).—Alloy constructional steels to Air Ministry specifications, in bar and sheet form; tool steels and cutting tools in high-speed steel and tungsten-carbide; stainless steels; heat-resisting steels; manganese steel skid shoes; steel castings, cutters and reamers; twist drills, files; permanent magnets and magnet steels; electrically butt-welded cutting tools.

One of the latest additions to the Desoutter (Para. 157) range—the pneumatic nibbler.

62 MORRIS AND INGRAM, 26, Finsbury Square, London, E.C.2 (Metropolitan 7757).—Hall eccentric valve-seat grinders for production and service, with planetary action and screw feed (for precision grinding in all sizes and metals); Sioux valve-face grinders (for valves of all sizes) for wet or dry grinding, with patented roller chuck; Graco high- and low-pressure lubricating equipment; Lectrolite chrome-vanadium steel wrenches in S.A.E. sizes.

63 POWER FLEXIBLE TUBING CO., LTD., London, N.4 (Stamford Hill 5428).—All types of flexible metallic tubing, including the following aircraft specialities: "Avioflexus" petrol and oil hose; "Duroflex" hose for hydraulic oil systems; flexible metallic bellows in various materials, including Tombac and stainless steel.

64 STEVENS BROTHERS (WOLVERHAMPTON), LTD., Retreat Street, Wolverhampton (Wolverhampton 20903).—Light engineering work; machined parts; assemblies; wire and tube manipulators; welding; light presswork, etc.

65 THOR HAMMER COMPANY, 94, Snow Hill, Birmingham, 4 (Central 8086/7/8).—"Thor" copper-rawhide hammers with renewable faces; all-rawhide hammers and mallets; all-copper hammers; also rawhide copper, lead, rubber and fibre spare faces.

66 THE HOYT METAL COMPANY OF GREAT BRITAIN, LTD., Deodar Road, Putney, London, S.W.15 (Putney 0406).—Manufacturers of bearings and bearing metals, including Hoyt "Number Eleven" metal, as used extensively for the bearings of high-powered aero engines of the most advanced design.

67 WILLIAMSON MANUFACTURING CO., LTD., Litchfield Gardens, Willesden Green, London, N.W.10 (Willesden 0073).—Eagle Aircraft cameras and equipment for survey photography and naval and military requirements; specialists in air photographic apparatus, hand-held cameras, pistol cameras for air snapshots; contractors to Air Ministry, Admiralty, War Office, Colonial and Foreign Governments.

68 MARCONI'S WIRELESS TELEGRAPH CO., LTD., Electra House, Victoria Embankment, London, W.C.2 (Temple Bar 4321).—Wireless transmitters and receivers for civil and military aircraft and aerodromes. Medium-wave D/F. receivers for use in aircraft and Marconi-Adcock medium-wave and short-wave D/F. receivers for land use. Screened and streamlined rotatable D/F. loops. Medium and ultra-short-wave approach beacons and ultra-short-wave beacon receivers. Transceivers. Linking apparatus, enabling wireless direction finders to be utilised in connection with the P.B. Deviator Automatic Pilot. Marconi-Newton generators and constant-speed windmills; winches, fairleads, etc., screening harness

69 AIRCRAFT COMPONENTS, LTD., Arle Court, Cheltenham (Cheltenham 5141).—Dowty internally sprung wheels; undercarriages and tail wheel units—retracting and non-retracting; complete hydraulic systems; high-pressure and high-delivery power-driven pumps; control valves—direct and remote operated; automatic pressure and flow cut-out valves; retraction jacks for undercarriages, flaps and bomb doors; electrical warning systems, indicators, buzzers, switches, ground maintenance equipment, inflation pumps.

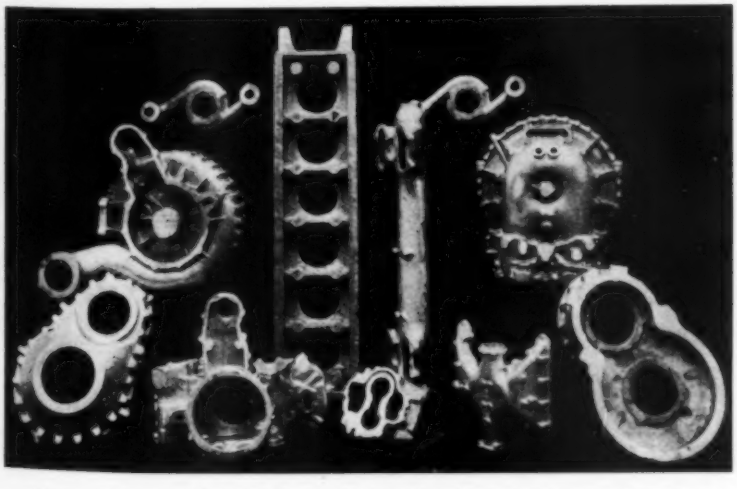
70 BOWDEN (ENGINEERS), LTD., Willesden Junction, London, N.W.10 (Willesden 2400).—"Bowdenex" general control cable assemblies, including tail, rudder and aileron trim controls; parachute flare release controls; cabin heater and landing light controls, etc.; "Bowdenex" landing wheel brake control, assemblies and connections; interconnecting assemblies for boost controls, carburettors, airscrews, etc.

71 ZENITH ELECTRIC CO., LTD., London, N.W.2 (Willesden 4087).—Electrical engineers; "Zenite" wire-wound vitreous-embedded resistances and special transformers for radio transmitters and receivers; "Variac" transformers and chokes; special transformers for aerodrome lighting.

72 REYNOLDS TUBE COMPANY, LTD., AND REYNOLDS ROLLING MILLS, LTD., Hay Hall Works, Tyseley, Birmingham, 11 (Acocks Green 1607).—Cold-drawn seamless steel tubes to all aircraft specifications; manipulated and built-up welded steel structures, such as engine nacelles and rings, etc.; high-strength light alloy tubes, extruded sections, rods and bars, in the Hiduminium and Magnuminium ranges of alloys; also manipulated tubes and sections in these materials; "Barronia" tubes for high-pressure hydraulic work up to 4,000 lb./sq. in.; high-strength light alloy sheets and strip to all current Air Ministry and B.S.I. specifications.

73 WELLWORTHY PISTON RINGS, LTD., Radial Works, Lymington, Hants (Lymington 520).—Wellworthy piston rings to Air Ministry specification 4K6 and D.T.D.233 for aero engines in Thermocrom patent material; Welflex patent compensating pistons, liners and liner castings; valve seat inserts; Wellworthy Simplex patent piston rings for use in worn bores.

74 THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby (Rugby 2121)—Electrical equipment for aircraft production; magnetos for all aero engines; electric starters; compressors for use with air starters, air brakes, gas starters; electrical equipment for wind tunnels; 16mm. sound reproducers for training purposes; sound amplifying equipment for announcements on flying grounds; Mazda lamps for illuminating hangars, aeroplane cabins, and floodlighting aerodromes.



Some intricate work by Aeroplane and Motor Aluminium Castings (Para. 107.)

THE ANCILLARY INDUSTRY (CONT.)

Retractable tail-wheel unit for a famous military aircraft, by Aircraft Components, Ltd. (Para. 69.)

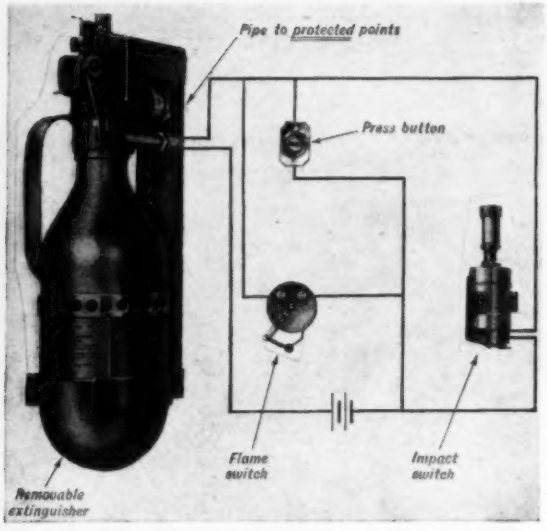
75 SARO LAMINATED WOOD PRODUCTS, LTD., 109, Kingsway, London, W.C.2 (Holborn 2255 and 3823). (Factory: Folly Works, Whippingham, Isle of Wight.)—"Saro" aircraft plywood to Air Ministry specification, supplied in thicknesses from 0.5mm. (3-ply) and 0.8mm. (5-ply) upwards in all sizes; aircraft plywood for fuselage covering, wing covering, spar webs, leading edges, etc., supplied in one piece shaped ready for assembling; aircraft parts incorporating plywood; "Saro" compressed and impregnated timber for spar flanges, etc.

76 COLAS PRODUCTS, LTD., Norman House, 105-109, Strand, London, W.C.2 (Temple Bar 0011).—Bituminous emulsions for the construction of all types of artificial surfaces on aerodromes, such as runways, aprons, hangar floors, car parks and roads; advice of experienced engineers on any surfacing problem freely available.

77 TAYLOR, TAYLOR AND HOBSON, LTD., Stoughton Street Works, Leicester (Leicester 20134) and 314, Regent Street, London, W.1 (Langham 4287/8).—Electric javelin etching equipment; optical gauging and measuring instruments; optical profile and screw-thread projection equipment.

78 MASSON SEELEY AND CO., LTD., Howick Place, Westminster, London, S.W.1 (Victoria 2151).—Precision machined components, assemblies, jigs, tools and fixtures; A.I.D. Approved inspection; contractors to Admiralty, War Office and Air Ministry; makers of Masseeley radial grinding attachments for grinding radii on milling cutters on any tool and cutter grinder.

79 LLOYDS AND CO. (LETCHWORTH), LTD. (Letchworth 139).—Grass-cutting equipment specially designed for aerodromes, units ganged up in teams from 5 to 11, cutting widths from 11ft. 6in. to 25ft.—as used by Fairey, Westland and De Havilland, and at Heston, Brooklands, Shoreham, Southampton, Bristol, Hamble,



"Auto-crash" aircraft fire extinguisher by the National Fire Protection Co., Ltd. (Para. 177.)

Robertson Air Heater for cabin warming systems. (Para. 219.)

Anstey, Singapore, etc.; Lloyds' "Autoscythe," for cutting of grass, weeds, or bracken in odd and rough corners; grass-cutting machinery of all types, hand and power, for sports grounds.

80 FESCOL, LTD., North Road, London, N.7 (North 3025/6/7).—Electro-chemical deposition of chromium on components of aircraft, such as oleo pistons, sliding sleeves or rods in undercarriage gear, operating parts in sprung wheel units, release gear catches, etc.; proprietors of trade name "Millichrome"; deposition of nickel on exhaust manifolds, airscrew shafts, etc.

81 F. GILMAN (B.S.T.), LTD., 195, High Street, Smethwick, Staffs (Smethwick 1202-3).—Flexible shaft drives for portable flexible drive tools and remote operation of controls and instruments; complete flexible-drive machines for sanding, grinding, drilling and polishing aero engines and airframes; sole manufacturers of "Titegrip" British-made rotary milling cutters, manufactured in full range of shapes with standard 6mm. shanks; also shapes with tapped heads and special long shanks.

82 WRIGHT, ANDERSON AND CO., LTD., Gateshead-on-Tyne (Gateshead 72246). London: Regent House, Kingsway, W.C.2 (Holborn 9811).—Structural steelwork for all purposes; hangar and factory specialists; clear spans up to 200ft. designed, fabricated and erected at home or abroad; contractors to Admiralty, War Office, Air Ministry, Crown Agents, Office of Works, etc.

83 JOHN HALL AND SONS (BRISTOL AND LONDON), LTD. Head Office: Broadmead, Bristol (Bristol 22101). London Office and Warehouse: 1-5, St. Pancras Way, London, N.W.1 (Euston 2262).—Approved manufacturers of aircraft dopes, paints, varnishes and cellulose lacquers for protection and decoration of wood or metal aircraft; stoving enamels and special finishes for aircraft engines.

84 DASHWOOD ENGINEERING, LTD., Croydon Road, Penge, London, S.E.20 (Sydenham 5161).—Precision aero parts, accessories, armament; machining, tool-making, welding, heat treatment, experimental work; master and crash switches, supply-dropping equipment, A.I.D. approved.

85 WILD-BARFIELD ELECTRIC FURNACES, LTD., North Road, London, N.7 (North 3082).—All types of electric heat-treatment furnaces; "Heavy-Hairpin" carburising, annealing and normalising furnaces; forced-air circulation furnaces for tempering; billet heating and heat-treatment of light alloys; electrode and resistance salt baths; lead, white metal and aluminium melting furnaces; continuous furnaces for all purposes, including bright annealing and clean hardening, and high-speed steel hardening furnaces; small muffle furnaces for works and laboratory use; Vickers Pyramid hardness-testing machine.

86 DOBBIE McINNES, LTD., 57, Bothwell Street, Glasgow (Central 2912).—Engine indicators for all speeds and pressures, including "Farnboro" electric indicator for aero engines; "Teledep" tank-depth indicators (including new differential type for small increments of depth); stability recorders, pressure gauges, viscometers, calorimeters, barometers, compasses, clocks and general engineering and navigational instruments.

87 SMITHS AIRCRAFT INSTRUMENTS, Cricklewood Works, London, N.W.2 (Gladstone 3333).—Designers and manufacturers of all types of aircraft instruments, including sensitive altimeters, artificial horizons, turn-and-bank and rate-of-climb indicators, undercarriage and flap position indicators, remote-reading equipment, etc.; test instruments; sole licensees of the Mark 1A automatic controls; distributors of Husun compasses and navigation instruments, K.L.G. aero sparking plugs and Petroflex aircraft tubing, etc.

88 AERONAUTICAL ACCESSORIES ASSOCIATION, Parliament Mansions, Victoria Street, London, S.W.1 (Abbey 2915).—Export agents to Korect Depth Gauge Co., Ltd.; Self-Priming Pump and Engineering Co., Ltd.; Specialloid, Ltd.; R. B. Pullin & Co., Ltd.; Aero Piston Ring Co., Ltd.; Superflexit, Ltd.; John Hall & Sons, Ltd.; Keelavite Co., Ltd.; Ernest Lake, Ltd. Exporters of all aeronautical materials, equipments and accessories. Resident representative in The Argentine, Australia, Belgium, Brazil, Bulgaria, Canada, Denmark, Estonia, Finland, Greece, Holland, Hungary, India, Italy, Latvia, Lithuania, Norway, Poland, Portugal, South Africa, Sweden, Switzerland, Yugoslavia.

89 BELLING AND LEE, LTD., Cambridge Arterial Road, Enfield, Middx (Enfield 3322).—Interference suppressors, mains filters, etc.; ignition suppressors for vehicles; plugs and sockets, terminals and other electrical connections; fuses and fuse-holders; aerial equipment and feeders. On A.I.D. list.

90 THE HUGHES-JOHNSON STAMPINGS LTD., Langley Green, Birmingham (Broadwell 1361).—Drop forgings in carbon steels and alloys; copper, yellow metal and aluminium alloys.

91 FLEXO PLYWOOD INDUSTRIES, LTD., Flexo Works, South Chingford, London, E.4 (Silverthorn 2666).—Plywood to B.E.S.A. specification 4V3, manufactured with synthetic resin cement, for wing and fuselage coverings and interior cabin panels.

92 ALFRED ROBERTS AND SONS, LTD., Deykin Avenue, Witton, Birmingham, 6 (East 1181/5).—Mechanical rubber articles of all kinds, moulded, extruded, and machined; rubber bonded to metal for engine mountings and other anti-vibration purposes.

93 BRITISH TIMKEN, LTD., Cheston Road, Aston, Birmingham, (East 1321).—Tapered roller bearings (in stainless steel for amphibian aircraft); parallel-roller bearings; deep-groove ball bearings; Timken wear and lubricant-testing machine.

94 CARBODIES, Coventry (Coventry 4121/2).—Panel and fairing pressings in all metals; complete float manufacture; manufacture of complete units—cowlings, tanks, monocoque frames, etc.

95 THOS. P. HAWKINS AND SON, LTD. (Calthorpe 1101/1102).—Split cotter pins in steel and non-corrodible materials; taper pins, solid and split; steel and brass gimp pins; escutcheon pins. Released under own A.I.D. Inspection.

96 E. B. MEYROWITZ, LTD., 11a, Old Bond Street, London, W.1 (Regent 5778).—"Luxor" goggles in several models, as worn by well-known pilots; prescription lenses can be fitted.

97 DE HAVILLAND AIRCRAFT CO., LTD., Hatfield, Herts (Hatfield 2345).—Controllable-pitch airscrews of the hydraulic-actuated constant-speed type, made at the company's Edgware factory under Hamilton Standard patents, and as standardised by nearly all the major airlines of the world and by most military air forces; sizes available cover engine range from 130 h.p. to 1,700 h.p. Factory is now tooling for production of Hydromatic quick-feathering airscrew

98 GERM LUBRICANTS, LTD., City Gate House, London, E.C.2 (National 9001/2).—Lubricants for all types of aero engines, as approved by leading manufacturers; "Germ" Motoil XH stocked at most aerodromes in this country; portable oil-handling equipment of practical design offered to larger consumers; official contractors to Air Ministry.

99 HORDERN-RICHMOND AIRCRAFT, LTD., Chesham, Bucks (Chesham 568/9).—Airscrew specialists and consultants; designers and manufacturers of wooden airscrews, test fans, and component parts of aircraft; licensed by The British Thomson-Houston Co., Ltd., for the B.T.H. reinforced protective coverings; producers of high-duty consolidated wood materials.

THE ANCILLARY INDUSTRY (CONT.)

100 RAYOID MANUFACTURING CO., LTD., Garth Road, Lower Morden, Surrey (Derwent 2272).—Colloidal coverings, both in sheet and liquid form, for wooden and metal airscrews, tubular work, instrument panels, fabrics and general application.

101 V. W. DERRINGTON, LTD., 159, London Road, Kingston-on-Thames (Kingston 3720).—Lightweight aero windscreens; aircraft manifolds, silencers and induction pipes; lightweight instantaneous opening and closing "Bonora" petrol, oil and radiator caps; aluminium cylinder heads for private and commercial vehicles, aircraft tenders, etc.

102 FRANK HOW AND CO., LTD., Trogon Wharf, Carnwath Road, Fulham (Fulham 2233/4).—Manufacturers of "Trogon" brand of lubricating oils, specialising in "Trogon" aero oils to D.T.D. 109 specification, as supplied to the Air Ministry; also "Trogon" anti-freezing oils, "Trogon" motor oils, and plant and machinery oils in general.

103 THOS. P. HEADLAND, LTD., 164/168, Westminster Bridge Road, London, S.E.1 (Waterloo 5353).—Sole agents for the "Dzus" self-locking fastener; stockists of aircraft steels, ferrous alloys and A.G.S. parts; special bolts and other parts to customers' requirements; also machine tools, small tools, aerodrome and workshop equipment.

104 AIRWORK GENERAL TRADING CO., LTD., Heston Airport, Hounslow, Middlesex (Hounslow 2345).—Aircraft and engine overhauls and repairs; aircraft repainting; wireless, night-flying equipment and auxiliary fuel tank installations; aircraft metal details and assemblies; timber work; fabric covering and doping; aircraft fuel and oil tanks; sheet-metal work; metal spraying and stove enamelling; anodic and heat treatment; sand-blasting and normalising; capstan, milling, shaping, bending and automatic machine work. Full Air Ministry approval.

105 EDWARD WEBB AND SONS (STOURBRIDGE), LTD. (Brierley Hill 7138/9).—Seed specialists and fertiliser manufacturers; site inspection, soil analysis; recommendations of fertiliser requirements and special grass seed mixtures suited to each individual case.

Four Incandescent fan-recirculated furnaces for aluminium alloy sheet annealing. In front of them is an electrically operated charging machine having a reach of 18ft. 6in. (Incandescent Heat Co., Ltd.—Para. 227.)

106 UNIVERSAL BOILERS AND ENGINEERING CO., LTD., Fulledge Mill, Burnley, Lancs (Burnley 3203).—Petrol tanks, oil tanks, cowlings, fairings, detail fittings, sub-assemblies, components; machine and capstan work.

107 AEROPLANE AND MOTOR ALUMINIUM CASTINGS, LTD., Wood Lane, Erdington, Birmingham, 24 (Erdington 2207/8/9).—Sand castings and die castings of all sizes in all aluminium alloys; aluminium cylinder heads and pistons produced by special process; heat-treated aluminium castings.

108 DARWINS, LTD., Sheffield (Sheffield 41341).—Steels and alloys to Air Ministry specifications; high-grade tool steels; high-speed steels; alloys for use at high temperatures; stainless steel in cold-rolled strip, bars and castings; hacksaw blades.

109 NORTHERN ALUMINIUM COMPANY, LTD., Bush House, Aldwych, London, W.C.2 (Temple Bar 8844), producers of light alloys; Alclad NA.26ST, having proof stress of 19 tons/sq. in.; choice of alloys simplified by introduction of DTD.390 to replace their Alclad alloys; extrusions up to maximum dimensions visualised; in forgings, propeller blades up to largest sizes projected; high strength castings to specification DTD.298, 304 and 361 (NA.226) and DTD.300 (NA.350) for stressed components; Noral paste used for aeroplane dope and priming paints.

110 SUPERFLEXIT, LTD., Buckingham Avenue, Slough, Bucks (Slough 778).—Flexible tubing for fuel and oil systems of all aircraft; refuelling hoses for aerodrome ground equipment; hoses for mobile tankers, etc. Tubing approved by Air Ministry for all types of fuel and oil at temperatures up to 100° C. (D.T.D. 1014).

111 THE MANGANESE BRONZE AND BRASS CO., LTD., Watling Street, Dunstable, Beds (Dunstable 533).—"Dynaflex" anti-vibration mountings for engines, radio, instruments, cowlings, tanks, etc.; shear rubber flexible couplings.

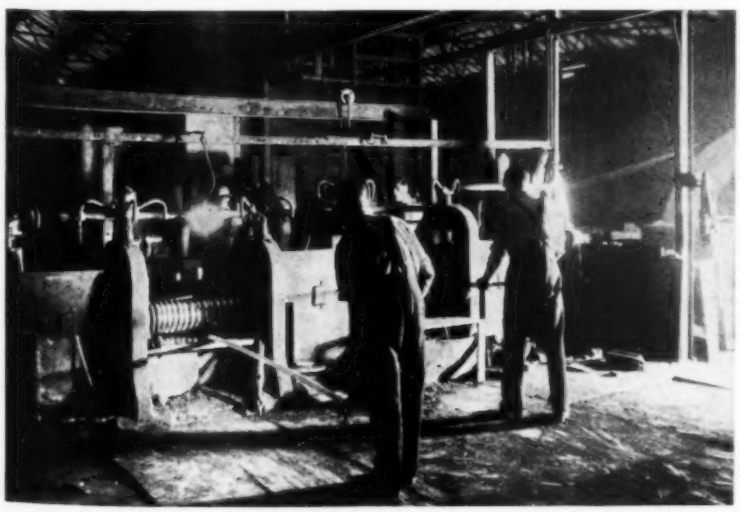
112 SIMMS MOTOR UNITS, LTD., Oak Lane, East Finchley, London, N.2 (Finchley 2262).—Manufacturers of aircraft magnetos, self-contained or with separate distributors; aircraft generators; parachute release boxes; synchronisers for magneto timing; petrol or oil indicators; repairs to all types of magneto.

113 BUTLERS, LTD., "Atlantic" Works, Grange Road, Small Heath, Birmingham, 10 (Vic. 2164/5/6).—Makers of aircraft landing lamps, searchlights, signalling lamps and fog lamps of various sizes and types; also all kinds of light and medium pressings to manufacturers' and Government specifications.

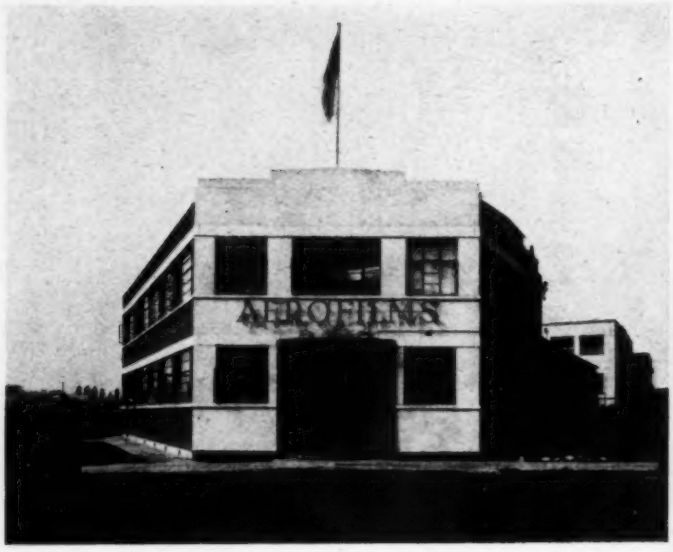
114 W. H. DORMAN AND CO., LTD., Stafford (Stafford 641).—Pressure die castings in aluminium to Specification L.33 for aircraft construction.

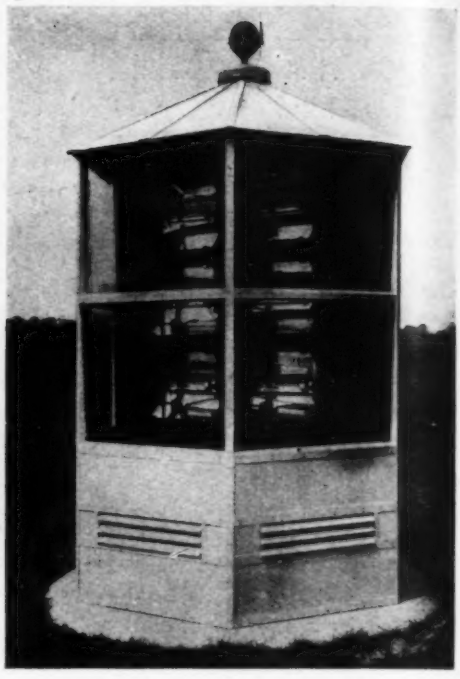
115 RAGOSINE OIL CO., LTD., Ibex House, Minories, London, E.C.3 (Royal 4372).—"Minix" aero oils (to D.T.D 109), approved by Air Ministry and engine manufacturers, as used by leading engine and aircraft manufacturers, also majority of training schools and many foreign governments. Large stocks of the following approved Air Ministry lubricants available for immediate despatch: D.T.D. 44 B, D.T.D. 143 B, D.T.D. 121 C, D.T.D. 72 Also industrial oils and cutting oils.

116 CRIMBLE OF STAINES, Kingston Road, Staines (Staines 1143).—Contractors to Air Ministry. Fordson tractors for aerodrome maintenance and construction; — wheeled or roadless track models; mobile cranes on pneumatic front wheels



Rolling alloy bars for aero engine work in the mills of Thos. Firth and John Brown, Ltd. (Para. 9.)





Above: The headquarters of Aerofilms, Ltd. (Para. 210) at Beresford Avenue, Wembley. Right: The latest type of 6 kW., six-lamp floodlight produced by Chance Bros. (Para. 196.)

with roadless track; 27ft. loading space articulated aircraft carriers powered by Fordson Commercial.

117 WEATHERLEY OILGEAR, LTD., Arch Street, London, S.E.1 (Hop 1142).—Hydraulic broaching machines; hydraulic forming, blanking, straightening and assembly presses; variable-speed transmissions; hydraulic equipment for all applications.

118 DUNLOP RUBBER CO., LTD., Fort Dunlop, Birmingham (Erdington 2121).—Dunlop high-pressure, low-pressure or intermediate wheel-less aircraft tyres and wheels; tail wheels with "Ecta" (electrically conducting) treads; pneumatic aircraft brakes, hand or foot operated; hydraulic brakes for hand or foot operation; power-driven hydraulic brakes; hydraulic and pneumatic water rudder installations; Anticer apparatus; machine gun firing and auto-cannon firing apparatus (pneumatic and hydraulic); rubber accessories of all types; Dunlopillo cushioning for seats, back-rests, cockpit edges.

119 V. L. CHURCHILL AND CO., LTD., Walnut Tree Walk, Kennington, London, S.E.11 (Reliance 3063).—Valve refacer, Type 44Y, for all aero engine valves; 50-ton hydraulic presses; electric valve lappers; aircraft service and flight tool-kits; airframe jacks and service equipment.

120 B. B. CHEMICAL CO., LTD., Ulverscroft Road, Leicester (Leicester 20175).—"Bostik" industrial adhesives for waterproof glazing, shell-plate sealing, sticking fabric, rubber and similar materials to metal and wood, and for all aircraft adhesive work.

121 BRITISH PRESSED PANELS LTD., Quinton, Coventry (Coventry 60207/8).—Manufacturers of fuselage panels, rudders, seats, tanks; sheet metal work and pressings of all types in all metals.

122 CLARKE, CHAPMAN AND CO., LTD., Gateshead, Co. Durham (Gateshead 72271).—Complete searchlight projectors and component parts, including lamps and reflectors; sound locators; aerodrome lighting equipment.

123 THE VALOR COMPANY, LTD., Bromford, Erdington, Birmingham, 24 (Erdington 1691). London Office: 120 Victoria Street, S.W.1 (Victoria 3934).—"Valor" steel equipment for offices and works; "Valor" fire extinguishers for various fire risks; petrol cans, measures, seals, oil filters, sheet metal work, steel pressings, brass cast taps and stampings

124 BROOM AND WADE, LTD., High Wycombe, Bucks (High Wycombe 630).—Single-stage and two-stage air compressors in many types and sizes; pneumatic tools for aircraft construction, general engineering duties and contractors' work; hose and connections; Swartwout moisture separators; general pneumatic equipment and accessories. Special tools for the Aircraft Industry, including lightweight drills, grinders, polishers, riveting hammers, pneumatic or hydro-pneumatic squeeze riveters of various sizes — portable or arranged for bench, column or cradle mounting.

125 KAYSER, ELLISON AND CO., LTD., Carlisle and Darnall Steel Works, Sheffield (Sheffield 22124).—K.E.965 special heat-resisting valve steel, as standardised in most leading British aircraft engines; various types of stainless steels to Air Ministry specifications; large quantities supplied in precision-ground bar; pioneers in the supply of precision-ground bars in all types of steel, including tool, high-speed, stainless, alloy and free-cutting mild.

126 AEROSTYLE, LTD., 174-6, St. John Street, Clerkenwell, London, E.C.1 (Clerkenwell 5963).—"Aerostyle" spraying equipment for spray-doping and finishing aeroplanes and structures; air compressors (stationary or portable), paint containers, spray guns, etc.

127 THE GLACIER METAL CO., LTD., Alperton, Wembley, Middlesex (Perivale 4271).—"Findlay's Motor Metal L.1" for aero engine bearings; main and connecting-rod bearings for aero engines, steel and bronze-backed, lined with anti-friction white metal, lead-bronze and other special alloys, and precision machined to assembly tolerances; bronze and steel camshaft bearings lined with white metal, etc.

128 MODERN MACHINE TOOLS, LTD., The Butts, Coventry (Coventry 2132).—London Depot, Park Royal Road, North Acton, N.W.10 (Willesden 5688).—Machine-tool merchants, standard machines of all types in stock, new, reconditioned and partly used. Special manufactures—3-operation automatics ⅝in. and 1¼in. capacity; belt-driven capstans 1in. and 1¼in. capacity; motorised capstans for high-speed turning work and for combined turning, screwing and forming; motorised thread millers; oil groovers for bush and spindle work.

129 W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Holborn Viaduct, London, E.C.1 (City 3210).—Cables and flexible cords for aircraft. Cables, jointing materials and accessories for power and lighting work in aerodromes.

130 CONSOLIDATED PNEUMATIC TOOL CO., LTD., 232, Dawes Road, London, S.W.6 (Fulham 7722).—Pneumatic and electric production tools and machines, including (specially suited for aircraft work) light riveting hammers, pneumatic compression riveters, power-vane pneumatic drills, and pneumatic and electric shearing machines.

131 B. DIXON-BATE, Bridge Works, Chester (Chester 1254).— Dixon Safeguard Control, an impact switch which operates in the event of a crash to disconnect any electrical gear and perform other functions; aerodrome beacon, self-contained, flashing neon light, battery-operated for land or water.

132 THE PATENT MOTOR PRODUCTS CO., 156, New Cavendish Street, London, W.1 (Museum 1221).—"Hermeticoll" liquid jointing for use in aero engines, etc., marketed in three sizes of tins and one-gallon drums.

133 BAUSCH AND LOMB OPTICAL CO., LTD., Africa House, Kingsway, London, W.C.2 (Holborn 6604).—Aircraft bubble sextant, newly designed, employing a semi-permanent bubble which may be enlarged or reduced instantly; Ray-Ban anti-glare sun glasses in special wide-field frames; prism binoculars and telescopes.

134 HYDRAN PRODUCTS, LTD., Hydra Works, Gresham Road, Staines (Staines 503).—"Hydra" oil burner for boilers, water-heaters and industrial heating, designed to burn efficiently a wide range of liquid fuels, from those of high grade to cheap, low-grade fuels and industrial residues.

135 MORRISONS ENGINEERING, LTD., Purley Way, Croydon (Croydon 0191-2).—Aeronautical and general engineers; tool-making; sub-assemblies; press-work; welding; A.G.S. parts; sheet-metal work and machining of all kinds; manufacturers of the Morrison patent automatic S O S transmitter for aircraft.

136 RANSOMES, SIMS AND JEFFERIES, LTD., Orwell Works, Ipswich (Ipswich 2201).—Manufacturers of machinery for preparation and maintenance of aerodromes, i.e., gang mowers specially designed for cutting aerodromes, mole drainers, disc harrows, drag harrows, land levellers, portable hangars, etc

THE ANCILLARY INDUSTRY (CONT.)

137 GEO. SALTER AND CO., LTD., West Bromwich (West Bromwich 0666).—Springs from all classes of material for every conceivable purpose; valve springs for aero engines; roller bearings.

138 L. A. RUMBOLD AND CO., LTD., Kingsgate Place, Kilburn, London, N.W.6 (Maida Vale 7366/7).—Aircraft silencing, furnishing and upholstery specialists; chairs, parcel racks, cabinets, tables, carpets, etc., for civil aircraft; pilot, gunnery, wireless observers and other types of seats for Service aircraft; blind-flying hoods and all types of superstructures (latter work under A.I.D. approved inspection).

139 ELECTRO DYNAMIC CONSTRUCTION CO., LTD., St. Mary Cray, Kent (Orpington 2560-2).—Lightweight motor generators, alternators, rotary transformers, etc., for aircraft.

140 GRIMSTON ELECTRIC TOOLS, LTD., Progress Way, Purley Way, Croydon (Croydon 0131).—Electric drills; Electriska high-production bench and column drills; double-ended bench and pedestal grinders; sheet-metal shears and rotary files.

141 KALOROIL BURNERS, LTD., Kingsbury Works, Kingsbury Road, London, N.W.9 (Colindale 8861-4).—Semi-automatic and fully automatic fuel-oil burners for heating hangars; special burners for using waste engine oil.

142 P. B. DEVIATOR, LTD., 93, Lansdowne Road, Croydon (Croydon 2989).—Automatic hydraulic controls for aircraft, capable of super-control from radio D/F, on any broadcasting station, thus providing for automatic navigation, and, for aerial survey work on suitable aircraft, ensuring a high-stability accuracy.

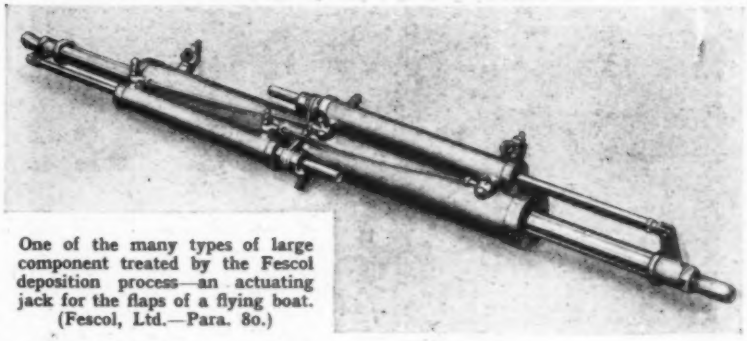
143 LIGHTALLOYS, LIMITED, Alpax Works, St. Leonards Road, Willesden Junction, London, N.W.10 (Willesden 3460/1/2).—Founders of aluminium alloy sand and die castings to all specifications, and responsible for the introduction of the corrosion-resistant silicon aluminium types, Alpax, Alpax Beta and Alpax Gamma (B.S.S.L.33 and D.T.D.240 and 245).

144 PYRENE CO., LTD. (Dept. F.E.), Great West Road, Brentford (Ealing 3444).—"Pyrene" pump-type and pressure-type fire extinguishers for aircraft and electrical plant; "Phomene" foam, fire extinguishers, engines and foam generators; "Pyrene" foam-making branchpipes for extensive outbreaks involving highly inflammable liquids or materials; "Pyrene" CO_2 equipment mainly suitable for interior fires involving highly inflammable liquids and electrical plant; "Pyrene-Pulsometer" trailer-type fire engines of 350 g.p.m. and 120 g.p.m. capacity, as supplied under H.M.O.W. contract for A.R.P. work.

145 THE AEROGRAPH CO., LTD., Lower Sydenham, London, S.E.26 (Sydenham 6060).—Manufacturers of spray-painting and finishing equipment, including spray guns for every painting and finishing purpose; pressure feed tanks in a wide range of sizes; booster and circulating material feed systems; air compressors and receivers; air transformers and regulators; safety spray booths and vapour-proof light reflectors; exhaust fans with special safety features; air and fluid hose; small and large complete portable outfits and oiling guns.

146 HERBERT CHAPPELL, LTD., 58, Conduit Street, London, W.1 (Mayfair 2242), and 50, Gresham Street, E.C.2 (Metropolitan 6837).—R.A.F. uniforms, flying clothing and helmets, Naval and Military kit and accoutrements, and civil tailoring.

147 MAY AND BAKER, LTD. (Rhodoid Department), 42/3, St. Paul's Churchyard, London, E.C.4 (City 6555).—Rhodoid (B.S.S. F.56) transparent cellulose acetate sheets (easily moulded) for aircraft windows, windscreens, gun turret windows, fairings, etc., in thicknesses of from 1 mm. to 6 mm.; transparent sheets in a thinner substance for inspection panels, instrument and chart covers; sheets in black, white and opaque colours for instrument plates and labels.



One of the many types of large component treated by the Fescol deposition process—an actuating jack for the flaps of a flying boat. (Fescol, Ltd.—Para. 80.)

148 BIRMINGHAM ALUMINIUM CASTING (1903) CO., LTD., Birmid Works, Smethwick (Smethwick 1213/4/5/6).—Castings in aluminium alloys and "Elektron" magnesium alloys to Air Ministry specifications for aero engines and aircraft; quantity production of smaller components by pressure die-casting and gravity die-casting processes in both "Elektron" and aluminium alloys; larger components, such as crankcases by the sand casting process; heat treatment of light alloys, both aluminium and "Elektron"; own pattern-making shops and die-making tool rooms of large capacity.

149 JAMES BERESFORD AND SON, LTD., Cato Street Works, Birmingham, 7 (Aston Cross 3256/7/8/9).—Makers of patent self-contained lightweight pressure aircraft W.C.s, pedal operated, as supplied to the Air Ministry; folding and swing wash-basins, weight as low as 7 lb. each; urinal equipment, light hollow stampings; circulating pumps; valves; self-closing cocks; flushing tanks and general sanitary equipment.

150 KELVIN BOTTOMLEY AND BAIRD, LTD., Kelvin Works, Winchester Road, Basingstoke (Basingstoke 690).—Associated with Kollsman Instrument Company of America, manufacturing an increasing range of aircraft instruments, including sensitive altimeters, standard altimeters and rate-of-climb indicators; engine speed indicators; Service and civil-type compasses.

151 BOOSEY AND HAWKES, LTD., Deansbrook Road, Edgware, Middx (Edgware 0222).—Seamless containers of awkward shapes by hydraulic bulging process; abnormal tube bending; all in light and very light gauges.

152 THE HADLEY COMPANY, LTD., Surbiton, Surrey (Emberbrook 2710).—All types of moulding from cellulose acetate sheet to Air Ministry specifications; windows, fairings, navigation and landing light covers, etc.; moulded ammunition chutes, goggles and eyeshields; small metal pressings.

153 BRITISH THERMOSTAT CO., LTD., Teddington Works, Windmill Road, Sunbury-on-Thames, Middlesex (Sunbury-on-Thames 456).—Thermostatic apparatus for aero-engine cooling; aircraft cabin temperature controls; automatic control equipment for heating, air-conditioning, refrigeration and industrial processes.

154 LONDON AND MIDLAND STEEL SCAFFOLDING CO., LTD., Iddesleigh House, Caxton Street, London, S.W.1 (Abbey 6483).—Burton's patent "Double Grip" tubular steel scaffolding for mobile staging, trestles, storage racks, etc.

155 WM. BARBOUR AND SONS, LTD., Hilden, Lisburn, N. Ireland (Lisburn 2277).—"Spinx" quality machine linen thread for aircraft work; threads, cords and twines to aircraft specifications 3F31, 3F32, 3F34, 4F35, F54.

156 W. AND J. KNOX, LTD., Kilbirnie, Ayrshire (Beith 7).—Linen machine thread, "Victoria" quality, for aircraft work; also threads and cordage to aircraft specifications.

157 DESOUTTER BROTHERS, LTD., The Hyde, Hendon, N.W.9 (Colindale 6346).—Specialists in lightweight portable pneumatic and electric drills; "Mighty Atom" straight and special close-corner drills; telescopic nose jig-drills; portable pneumatic nibbler and shears; electric and pneumatic screwdriver and nut-runners; portable pneumatic grinders; and other special tools developed for the aircraft industry.

158 HEPWORTH AND GRANDAGE, LTD., St. John's Works, Bradford (Bradford 11100).—Hepolite piston rings of all kinds, also "Phormicast" high-pressure rings; Hepolite pistons of all classes in cast iron, Y-alloy, Heplex low-expansion silicon alloy; J.H.P. patent expanding, Nelson Bohnalite Inwarstrut and R.S. compensating pistons; cylinder liners of all sizes and types in Hepolite wear-resisting Vacrit iron; Hepolite gudgeon pins in all classes of steel, including Air Ministry specifications.

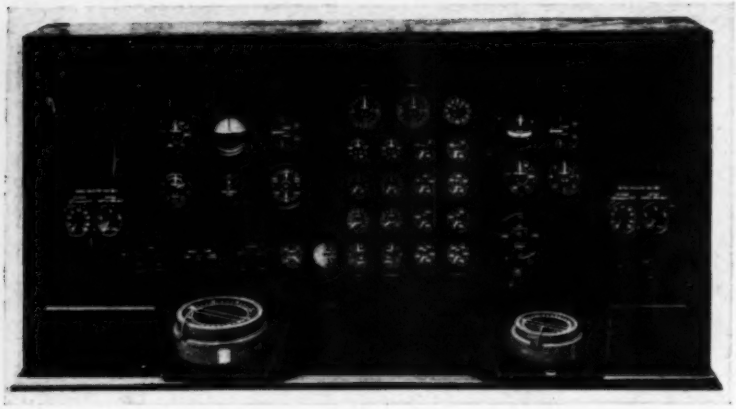
159 THOMAS CHATWIN AND CO., Great Tindal Street, Birmingham (Edgbaston 3521/2).—Special parts and components; taps, dies, drills, reamers, from relieved special spline cutters; ground-thread hobs; chasers; jigs; gauges; screwing machines.

160 ESAVIAN DOORS (controlled by The Educational Supply Association, Limited), 181, High Holborn, London, W.C.1 (Holborn 9116).—Esavian folding and sliding wooden hangar doors in heights up to 40ft. or over and *any* width; operated either electrically or by hand; weight carried on floor movements running on track fixed in concrete; opened or closed in from ½ min. to 1 min. according to size.

161 PETO AND RADFORD, 50, Grosvenor Gardens, London, S.W.1 (Sloane 7164).—Accumulators for aircraft, suitable for engine starting, cabin lights, radio, undercarriage actuation, etc.; special types of varying capacities made for aerobatic and non-aerobatic machines; high-capacity accumulators for ground starting.

162 BRAYSHAW FURNACES AND TOOLS, LTD., Belle Vue Works, Manchester, 12 (East 1046).—Specialists in salt baths and fusible salts for aircraft metals and alloys; manufacturers of all types of furnaces suitable for forging, melting, carburising, tool hardening, tempering and other heat-treatment processes, using town's gas, fuel oil or electricity as the heating medium.

163 CHILLCOTTS, LTD., 25, Short Street, Blackfriars, London, S.E.1 (Waterloo 4091/2).—Vellumoid, Vellutex, Fibracork jointing materials for all classes of aircraft gasket work; "Paroid" synthetic rubber products made in many forms of sheets and mouldings for all classes of oils, petrols, acids, alkalis solvents, etc.; separate works engaged on all classes of sheet steel and light constructional work, including silencers, trucks, trolleys, trays, machine guards, etc.



Demonstration panel of Smith's aircraft instruments (Para. 87), with standard blind-flying panel near the left.

164 FOLLAND AIRCRAFT, LTD., Hamble, Southampton, Hants (Hamble 345).—Designers and constructors of aircraft; specialists in all-metal aircraft construction; such components as parts of fuselages, floats, tail units, ailerons; machine-shop work and tools; reconditioning and repair of Imperial Airways Empire boats.

165 R. K. DUNDAS, LTD., The Airport, Portsmouth, and Civil Aerodrome, New Delhi, India. Factory: Beatrice Road, Southsea (Portsmouth 6078 and 31120).—Representatives for aircraft manufacturers and the allied industries in India; factors and stockists of aircraft spares, accessories and aerodrome equipment throughout India and Burma; sub-contractors and manufacturers of aeronautical and marine components, machining and sheet-metal work; makers of fuel and oil tanks, metal rib assemblies, tubular engine mountings, cowling, undercarriages, seats, etc. Contractors to the Admiralty.

166 WALTER MAYS, LTD., Abbey Cork Mills, London, S.W.19 (Liberty 3764).—"Everything in cork"; carburettor and oil indicator floats, gauge glass washers, gland packings, strut sealing corks, anti-vibration mats, composition cork jointing to D.T.D.219A, laminated and plain.

167 SHELL-MEX AND B.P., LTD., Shell-Mex House, Victoria Embankment, London, W.C.2 (Temple Bar 1234).—Distributing organisation for the Shell and Anglo-Iranian oil groups; aviation fuels and lubricants to Air Ministry Specification at aerodromes at home and abroad; Carnet and air touring services; 100-octane and special fuels.

168 ELFSON, LTD., Tyburn Road, Birmingham, 15 (East 1692).—Precision engineers and machinists specialising in the production of metal hubs and sleeves for aircraft and general machining of aircraft components.

169 PAK PARACHUTE CO., LTD., 175a, Streatham Road, Mitcham, Surrey (Mitcham 2601).—Parachutes (man and supply dropping), air targets of all descriptions, wind indicators, signal cones; all types of high-class sewing.

170 AUTO-KLEAN STRAINERS, LTD., 40, Trinity Square, London, E.C.3 (Royal 5044).—Auto-Klean and Lokos self-cleaning petrol and lubricating oil filters for all sizes of aero engines; fine mesh filters for use on aero-engine test-beds; special filters for the protection of hydraulic control systems.

171 BIRMINGHAM BATTERY AND METAL CO., LTD., Selly Oak, Birmingham (Selly Oak 1151).—Manufacturers of copper tubes to all specifications, and as supplied for Empire flying boats; brass radiator sheets; copper and brass sheets and strip.

172 BRITISH ALUMINIUM CO., LTD., Adelaide House, King William Street, London, E.C.4 (Mansion House 5561 and 8074).—Aluminium and aluminium alloys to Air Ministry specifications; ingots, notched bars, sheets, strip, circles, matting, drawn and extruded sections; bars, rods, tubes, wire, rivets, etc.

173 JAMES H. RANDALL AND SON, LTD., Paddington Green Works, North Wharf Road, London, W.2 (Ambassador 1661/2/3/4).—Fully equipped for the production of all kinds of metal spinnings; light sheet-metal work, coppersmithing; pipe work for all kinds of aircraft; also tanks, seats, cowling, fuselage panels, induction and exhaust pipes, etc.

174 THOMPSON BROS. (BILSTON), LTD., Bradley Engineering Works, Bilston, Staffs (Bilston 41624/8).—Aircraft refuelling tenders, 300 gall. to 1,000 gall. capacities, hand or power operated; sheet-metal components for aircraft; exhaust manifolds; petrol storage tanks for aerodromes, 500 gall. to 12,000 gall. capacities.

175 BROWN BROTHERS, LTD., Browns Buildings, Great Eastern Street, London, E.C.2 (Bishopsgate 7654).—Aerodrome and workshop equipment, including air compressors, electric drills, cranes, trestles, aero jacks, lighting, filters, spraying plant, presses, testing equipment, welding plant, cleaning tanks, engine stands, petrol pumps, refuelling units, fire fighting equipment, workshop furniture, Forwell re-metalling outfit, tools.

176 BROWN BROTHERS (AIRCRAFT), LTD., Great Eastern Street, London, E.C.2 (Bishopsgate 7654).—Aircraft equipment, including bolts, nuts, rivets, pins, screws, fork joints, turnbuckles, A.G.S. parts, filters, tank fittings, bonding clamps, insulating sleeves, terminals, wire, repetition parts; screw thread gauges; metals, steel bars, sheets, duralumin; aircraft clothing.

177 THE NATIONAL FIRE PROTECTION CO., LTD., Richmond, Surrey (Richmond 2342).—Aeronautical fire protection and general engineers (A.M. Approval No. 426856/35); "Essex" methyl bromide extinguishers; "Featherspray" hand, automatic and "Essex" automatic anti-crash installations for aircraft; airport fire tenders and trucks; "Richmond" soda-acid and foam extinguishers; "Sheen" carbon tetrachloride extinguishers; optical and thermostatic fire detection systems; vapour detectors; first-aid equipment; A.R.P. miscellanea; general engineering work.

178 LODGE PLUGS, LTD., Rugby (Rugby 2076).—Makers of Lodge sparking plugs for all types of aircraft engines, including radio-screened types; also radio-screened cable terminal fittings for use with either conduit-type screening harness or metal braided cable.

179 E. G. BROWN AND CO., LTD., West Road, London, N.17 (Tottenham 2257/8/9).—Sheet-metal workers; panel beating, pressings, stampings and welding, general engineering and light constructional works, in steel, aluminium or alloys; manufactures include De Bergue riveted or welded fuel and oil tanks up to 300 gallons, nose

THE ANCILLARY IN[STR]

cowls pressed and welded in a variety of shapes, pilot seats with various types of fittings, exhaust manifolds, wheel spats, air intakes and ducting, engine fairings; all-metal bodies and cabs for ground services; patent refrigerated photographic vehicle bodies, all-metal double-shell insulated construction, complete with electrical equipment, stainless-steel sinks and fittings.

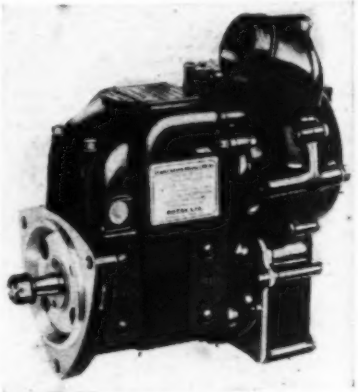
180 SILVERTOWN LUBRICANTS, LTD., Minoco Wharf, W. Silvertown, London, E.16 (Albert Dock 3131).—Speedolene aero engine oil and Silvertown P.4 aero engine oil, both to Air Ministry specification DTD.109; "Silarctic" Oil to specification DTD.44B; "Silarctic" grease to specification DTD.143B; cutting, drilling, cooling oils and greases for all industrial purposes; Silvertown aero oils approved by the makers of every British aero engine, and used in large quantities by the R.A.F. and important manufacturers; Speedolene is available at leading aerodromes.

181 ELLIOT EQUIPMENT AND ACCESSORIES, LTD., Cardiff (Cardiff 875); London: Cecil Chambers, 86, Strand (Temple Bar 7987).—Safety belts; Sutton harness; aircraft cables; all forms of wire rope and hemp rope splicing; parachutes, etc.

182 M.C.L. AND REPETITION, LTD., Pool Lane, Langley, Birmingham (Broadwell 1115).—Auto-turned repetition products of all kinds from the bar in free-cutting steels, high-tensile steels, brass, bronze, copper, aluminium, Duralumin, Monel metal, aircraft steels, and all plated finishes (Cadmium silver, nickel, gold, chromium, etc.), to customers' special requirements; lighting equipment.

183 CELLON LIMITED, Richmond Road, Kingston-on-Thames (Kingston 1234).—All grades of aircraft finishes to the requisite Air Ministry specifications, including Cellon dopes, "Cerrux" synthetic finishes, "Cerric" cellulose finishes and "Cerrex" chromated primers; Cellon patented process for the covering and protection of rivets by means of specially coated metallic strip; Cellon dopeproof tape, and all sundries for the finishing shop.

184 THE "SQUARE GRIP" REINFORCEMENT CO., LTD., Windmill Road, Sunbury, and Team Valley Trading Estate, Gateshead (Sunbury 2772/3, and Low Fell 76081).—Reinforced concrete hangar floors, walls and roofs; concrete roadways, aprons, runways; aerodrome buildings and underground stores; as approved by the Air Ministry and used in many R.A.F. and civil aerodromes throughout the country; "Square Grip" fabric reinforcement supplied in flat sheets in all sizes and weights within two days from receipt of instructions.



Rotax double-contact breaker magneto, Type SP9-6, as used on the Bristol Pegasus engines of the Empire flying boats. (Para. 400.)

INDUSTRY (CONTINUED)

Indispensable in air traffic operation —the Aldis daylight signalling lamp. (Para. 36.)

185 RANSOME AND MARLES BEARING CO., LTD., Newark-on-Trent (Newark 456/7/8/9).—Manufacturers of all types of ball and roller bearings for engines, aircraft controls, etc., including chromium-plated or stainless-steel bearings fitted with retaining plates and filled with lubricant; latest type of needle roller bearings, with rollers held in a cartridge.

186 BRITISH LANDING GEARS, LTD., 4, Milner Square, London, N.1 (North 2431).—Designers and patentees of three-wheel undercarriages, wherein the third wheel is mounted aft of the main wheels on a retractable oil and air-damped leg in place of the normal tail wheel or skid.

187 THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Exide Works, Clifton Junction, near Manchester (Swinton 2011).—Exide batteries for aircraft to Aircraft Ministry specification; battery-operated ground starting equipment for aeroplanes; battery parts and spares; Exide batteries for wireless; Exide trickle-charging equipment; "Keepalite" system of emergency lighting.

188 CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., Hamilton House, Victoria Embankment, London, E.C.4 (Central 5241).—Special range of electric cables covering all aircraft requirements in accordance with Air Ministry specifications; cables and accessories for every electrical purpose, including lighting, power, welding, etc.

189 AUTOMOTIVE PRODUCTS COMPANY, LTD., Tachbrook Road, Leamington Spa (Leamington Spa 1400).—Lockheed hydraulic controls for the operation of undercarriages, flaps, bomb hoists, bomb doors, constant-speed propellers, spar-pin equipment, etc.; complete retractable undercarriage units; "Airdraulic" undercarriage and tail-wheel struts.

190 AVERY EQUIPMENT, LIMITED, Tachbrook Road, Leamington Spa (Leamington Spa 1700).—Avery aero wheels and brakes; Avery self-sealing couplings.

191 DIAGRID STRUCTURES, LTD., Horseferry House, Westminster, London, S.W.1 (Victoria 7663).—Licensors for Diagrid patented designs; consultants and designers for all types of Diagrid aeroplane factories and workshops, and civil and military hangars; long-span Diagrid floors and roofs with minimum structural depth and unobstructed roof space, at economic cost, in structural steelwork or reinforced concrete

192 MALLOCK - ARMSTRONG EAR DEFENDER CO., 39, Victoria Street, London, S.W.1 (Abbey 7113).—Manufacturers of ear defending appliances for use in protecting the hearing from explosive and other excessive noises (as supplied to the Royal Air Force and the leading aircraft and aero-engine constructors in England and abroad).

193 THE RENOLD AND COVENTRY CHAIN CO., LTD., Renold Works, Didsbury, Manchester, 20 (Heaton Moor 2231).—Steel transmission chain for operating flying controls, such as ailerons, throttle, altitude and petrol controls; and for non-flying controls, such as on seat operating gear and retractable undercarriages.

194 WEBLEY AND SCOTT, LTD., Premier Works, Birmingham, 4 (Central 7854).—Aviation signal pistols; machinists of aero engine and pump details.

195 WAYNE TANK AND PUMP CO., LTD., Wayne Works, Newlands Park, London, S.E.26 (Sydenham 7055/9).—Electrically operated petrol and oil pumps; airport refuelling pits; complete underground storage tank installations for petrol and oil; special equipment for petrol and oil dispensing designed and manufactured to requirements.

196 CHANCE BROTHERS AND CO., LIMITED, Lighthouse Works, Smethwick, Staffordshire (West Bromwich 1051).—All forms of aviation lighting equipment, including landing floodlights (both fixed and mobile types); landing direction indicators (wind operated and motor or remote controlled); boundary lights; obstruction lights; aerodrome beacons; airway beacons; runway marker or contact lights; automatic diesel-electric standby plant.

197 SALFORD ELECTRICAL INSTRUMENTS, LTD., Peel Works, Silk Street, Salford, 3 (Blackfriars 8888).—Altimeters, engine speed indicators, tail drift sights, plan range finders, multi-range AC/DC test sets, and a wide variety of electrical and allied measuring instruments.

198 B. O. MORRIS, LTD., Shirley, Birmingham (Shirley 1237).—"Morrisflex" flexible-shaft machines; "Rex" rotary files and cutters; "Dumore-Rex" patent constant peripheral speed grinders; patent "non-stop" dual-control, double-ended polishing machines; machinists to the aircraft industry; polishing mops, felts, and materials of all kinds; "Rex" grinding wheels.

199 ERNEST TURNER ELECTRICAL INSTRUMENTS, LTD., Chiltern Works, High Wycombe, Bucks (High Wycombe 301).—Specialists in design and manufacture of electrical measuring instruments, including milliammeters, ammeters and thermocouple instruments, also moulded bakelite parts for use in radio, wireless beacon and electrical equipment in civil and military aircraft and aerodromes; contractors to Air Ministry, Imperial Airways and important airway operating concerns, also to aero engine, aircraft, and wireless manufacturers throughout the British Empire.

200 C. C. WAKEFIELD AND CO., LTD., Wakefield House, Cheapside, London, E.C.2 (City 4411).—"Castrol" aero oils, available at aerodromes at home and throughout the Empire; Carnet and air touring service; engine lubricating oils to Air Ministry specification; industrial oils.

201 LINDSAY - NEALE AVIATION, LTD., 4, Park Lane, W.1 (Mayfair 8627/8).—Aeronautical consulting, aircraft demonstration and test flying; suppliers of hangars, crash-tenders, fire extinguishers, crash gear, first-aid equipment, wind stockings, steering brackets, flags, masts, office buildings, etc.

202 HEENAN AND FROUDE, LTD., Worcester (Worcester 391).—Froude dynamometers, Froude wind tunnel testing plants, Heenan electric dynamometers, Heenan dynamatic dynamometers; complete equipment of engine test shops; water coolers, oil coolers for the heat-treatment of steel, wire-forming machines, refuse incinerators, mechanical balers for scrap and salvaged material; iron and semi-steel castings.

203 ELLIOTT BROTHERS (LONDON), LTD., Century Works, Lewisham, S.E.13 (Tideway 3232).—Makers of instruments and electrical equipment used in the aircraft industry; flowmeters for the measurement of fuel flow; indicating accelerometers for aeronautical work; wind speed and direction indicators for airports and aerodromes; vibration tachometers; miniature electrical measuring instruments; aircraft position indicator for airports.

204 WESTON ELECTRICAL INSTRUMENT CO., LTD., Cambridge Arterial Road, Enfield, Middlesex (Enfield 3434).—Aircraft thermometers of the electrical type, requiring only a flexible wire connection between instrument and temperature point; made in a thermocouple type for use on engine cylinders and a resistance bulb type for measuring lower temperatures; electrical tachometer for engine speed measurement also available.

205 TRIPLEX SAFETY GLASS CO., LTD., 1, Albemarle Street, London, W.1 (Regent 8171).—Servicing and distribution of "Perspex," all-British transparent resin in sheet form, as approved by the Air Ministry for use on all types of British aircraft produced by I.C.I. (Plastics) Ltd., a subsidiary company of Imperial Chemical Industries, Ltd.

206 WILLIAM ASQUITH, LTD., Halifax (Halifax 61258).—Machine tools for aero engine and airframe manufacture, including profiling machines, wing-spar drilling machines, taper hole boring machines for variable-pitch propellers, keyway-cutting machines, standard radial and vertical drilling machines, special multi-spindle machines, etc. Sole representatives for the British Isles: Drummond (Sales), Ltd., King Edward House, New Street, Birmingham, 2 (Midland 3431).

207 AVIATION DEVELOPMENTS, LTD., Argyle House, 29-31, Euston

The Short Mayo Composite lands at Heston! Otherwise a fine piece of model-making by Woodason Aircraft Models. (Para. 44.)

Road, London, N.W.1 (Terminus 6288).—Specialists in blind riveting; Chobert system; A.V.R. patent sheet grippers; inspection doors, cowling clips, turned parts, etc.

208 PHŒNIX STEEL TUBE CO., LTD., Phœnix Street, West Bromwich (West Bromwich 1017/8).—Manufacture and testing, in large quantities, of cold-drawn seamless steel tubes, in round, square, oval, streamline, or any other special section, conforming to the various Air Ministry specifications; manipulating department for dealing with all classes of bent and manipulated parts, including welding of components; complete machining facilities available for dealing with fabrication, such as turning, grinding, drilling, reamering, facing, screwing, or any special machined requirements.

209 THE AERO PISTON RING CO., LTD., Aero Works, Black Bull Street, Leeds, 10 (Leeds 20936/7).—High quality piston rings for internal combustion engines of all types; sole manufacturers of "Aero" Controil and Multivent oil control rings.

210 AEROFILMS, LTD., Beresford Avenue, Wembley, Middlesex (Wembley 1461/2/3); London Office and Library, Bush House, Aldwych, W.C.2 (Temple Bar 2164).—Ordnance Survey contractors, and activities covering oil producing areas, town-planning schemes, new road and railway projects and revision of out-of-date Ordnance plans for local authorities, etc., technical development includes the installation of automatic plotting machine, new Wild Autograph A.5, battery of de Koningh stereoscopes and stereometers, Cambridge Instrument Company's Stereo Comparator, and new ultra-wide-angle Ross-Williamson air camera; library of 55,000 pictorial air views available at Bush House.

211 THE MAVITTA DRAFTING MACHINES, LTD., Anchor Works, Park Road, Aston, Birmingham, 6 (East 0482)—Adjustable ball-bearing drafting machines, for horizontal and vertical boards, various sizes and entirely British made; micrometer adjustment of quadrant to standard on all machines in the immediate future.

212 BAKELITE, LIMITED, 68, VICTORIA STREET, LONDON, S.W.1 (Victoria 5511).—Manufacturers of moulding materials: Laminated materials for electrical insulation and decorative purposes and for silent gears; synthetic resins for the production of durable paints and varnishes; lacquers for the preservation of metal parts and stoving varnishes for the impregnation of coils and other electrical windings; Bakelite "Plybond" rot-proof adhesive for plywood.

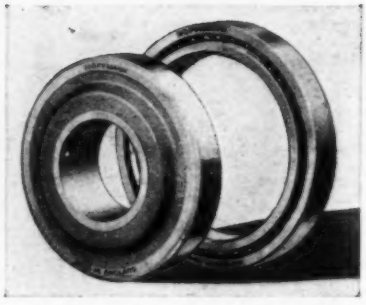
213 R. MALCOLM, LTD., 433, Perth Avenue, Trading Estate, Slough, Bucks (Slough 1750).—Aircraft and general metal work; specialists in cowlings, fairings, spats, tanks, detail fittings, tools and jigs; A.I.D. approved.

214 ROTOL AIRSCREWS, LTD., Cheltenham Road, Gloucester (Churchdown 322).—Designers and manufacturers of the Rotol constant-speed full feathering and non-feathering airscrews with hydraulic or electric operation for aero engines of 800 h.p. and upwards; Rotol adjustable-pitch airscrews; airscrew blades in magnesium and wood; spinners.

215 LEWIS SPRING CO., LTD., Redditch (Redditch 72).—On Air Ministry list of approved contractors, specialising in small spring pressings and fine wire coil springs, etc.; A.G.S. parts such as ferrules, bonding clips, etc.

216 AIRCRAFT GENERAL SUPPLIES, LIMITED, London Air Park, Feltham, Middlesex (Feltham 2627).—Aeronautical factors; manufacturers and stockists of all A.G.S. parts.

217 SIEBE, GORMAN AND CO., LTD., 187, Westminster Bridge Road, London, S.E.1 (Waterloo 6071).—Oxygen breathing apparatus for high-altitude flying; test apparatus for oxygen breathing apparatus; oxygen compression pump for cylinder charging; fuel flow indicators; calibrating apparatus for altimeters and air-speed indicators; electrically heated and other aircraft clothing; safety belts and harness; collapsible dinghies.



Small bearings for aircraft controls by the Hoffmann Manufacturing Co. (Para. 43).

218 THE REVVO CASTOR CO., LTD., Archdale Works, Blechynden Street, London, W.11 (Ladbroke 2609).—Ball bearing swivel castors of patented construction for nearly all purposes, including industrial trucks, hospital and medical equipment, furniture, etc.; unbreakable truck castors with the swivelling parts made in steel drop forgings and lighter types of pressed-steel construction; fixed castors; cast-iron wheels, solid rubber wheels and rubber-tyred wheels with plain bearings and roller bearings.

219 ROBERTSON COOLERS, LTD., 211a, Acton Vale, London, W.3 (Shepherd's Bush 1944).—Manufacturers of oil coolers, high- and low-pressure water radiators, ethylene glycol units and cabin-heating equipment; construction largely in aluminium, embodying mechanical type of solderless joint.

220 RADIO TRANSMISSION EQUIPMENT, LTD., 45, Nightingale Lane, Balham, S.W.12 (Battersea 7771).—Contractors to all Government Departments; manufacturers of aircraft radio equipment, including homing receivers, navigational beacons and beacon receivers for blind landing; aircraft standard transmitters of 50 and 100 watts output on long and short waves; marine equipment including D/F gear, navigational beacons, all-wave receivers and ship transmitters.

221 BROOKLANDS AVIATION, LTD., Brooklands Aerodrome, Weybridge, Surrey (Byfleet 436/7/8).—Aircraft sales, service and repairs. Contractors to Air Ministry. Proprietors of Brooklands Flying Club, Weybridge; Northamptonshire Aero Club, Sywell, Northampton; South Coast Flying Club, Shoreham Airport, Sussex.

222 FAIREY AVIATION CO., LTD., Hayes, Middlesex (Hayes, Middlesex 400).—Fairey-Reed metal airscrews in two-blade type (one-piece, with central twist at hub-block) and three-blade type (blades clamped at root between driving rings); hydraulically and mechanically controllable-pitch airscrews likely to be available shortly.

223 TUNGUM SALES COMPANY LIMITED, Iddesleigh House, Caxton Street, London, S.W.1 (Abbey 3509).—Tungum non-ferrous alloy, to Air Ministry specifications, offering high resistance to vibration and to sea-water corrosion, combined with exceptional strength and rigidity; in tubes, sheets, bars, rods and wire.

224 BALDWINS LIMITED, Midland Branch, Stourport-on-Severn (Stourport 10).—Sheets of all types for aircraft work to A.I.D. inspection, including Specifications S.84, 3.S.3, 3.S.20, DTD.12B, Admiralty TFB.4 and TFB.5 B.S.S. specifications. Silicon sheets and stampings for electrical purposes; auto body sheets, tinned sheets, Tin-Terne sheets and lead-coated sheets.

225 THE WALTER KIDDE CO., LTD., Belvue Road, Northolt, Middlesex (Waxlow 1061/2/3).—Specialists in the application of carbon dioxide "Lux" fire-fighting apparatus, as extensively used by the Royal Air Force and as standard equipment in the U.S. Air Service; Kidde flotation gear, as adopted by Great Britain and many other countries.

226 ROLLASON AIRCRAFT SERVICES, LTD., Croydon and Hanworth Airports (Croydon 5151).—Air Ministry direct contractors for repairs and modifications of military aircraft; Civil C. of A. and repairs to all types; complete engine overhauls; De Havilland agents and stockists; B.A. Swallow spares; private aircraft housed; full routines carried out; licensed ground engineers. Manufacture department (705 approval) handles large contracts for major components and sub-assemblies; machined parts; design and manufacture of tools, jigs and fixtures.

227 THE INCANDESCENT HEAT CO., LTD., Cornwall Road, Smethwick, Birmingham (Smethwick 0875).—Industrial furnaces and equipment, including salt baths for the treatment of aluminium alloys, continuous aluminium billet-heating plant, recirculated atmosphere furnaces for annealing aluminium, carburising and refining furnaces for aero engine parts, electrically operated furnace charging machines.

228 IRVING AIR CHUTE OF GREAT BRITAIN, LTD., Letchworth, Herts (Letchworth 888).—Parachutes of all kinds, with or without quick-release harness; special chair-type parachutes for cabin aircraft; "Irvinsuit" lambskin flying clothing with easy-fitting Zipp fastening.

229 G. AND M. LANE AND CO., LTD., 24/26, Ludgate Hill, London, E.C.4 (City 5885).—"Aeroplane" and "Aero" precision watches for service conditions—waterproof, shockproof, non-magnetic.

230 KORECT DEPTH GAUGE CO., LTD., Purley Way, Croydon (Thornton Heath 3868/9).—Manufacturers of all classes of diaphragm instruments, such as fuel pressure gauges, oil pressure gauges, fuel depth gauges, air-speed indicators, rate of climb instruments, and the like (speciality, lightness of instrument).

231 THE SELF-PRIMING PUMP AND ENGINEERING CO., LTD., 147, Edinburgh Avenue, Trading Estate, Slough (Slough 1760).—Makers of petrol pumps of all types; double-diaphragm pumps delivering up to 280 gallons, and single-diaphragm pumps delivering up to 70 gallons; hand-operated pumps delivering up to 50 gallons; electrically driven remote-unit pumps, etc.; pressure-regulating valves.

232 H. W. WARD AND CO., LTD., Dale Road, Selly Oak, Birmingham, 29 (Selly Oak 1131).—Specialists in the manufacture of ungeared and geared capstan lathes, combination turret lathes with patent covered beds, tools, toolholders, chucks and accessories for use on capstan and turret lathes.

233 BATTERIES, LTD., Hunt End Works, Redditch, Worcs (Astwood Bank 37).—"NIFE" nickel-cadmium alkaline batteries, with steel plates and employing an alkaline solution to eliminate sulphation, etc.; suitable in every way for engine starting as well as for lighting and wireless apparatus; as specified by the R.A.F. and Imperial Airways, Ltd.

234 ZINC ALLOY RUST-PROOFING CO., LTD., Shakespeare Street, Wolverhampton (Wolverhampton 20647/8).—Sherardizers of machined and intricate aircraft steel fittings (process approved by A.I.D. in Design Memorandum No. 323, to Specification D.T.D.908), producing a rust-proof alloy and uniform protection in steel surfaces.

235 SERCK RADIATORS, LTD., Warwick Road, Birmingham, 11 (Victoria 0531).—Manufacturers of radiators, oil coolers, header tanks, and cabin heating equipment for all types of aircraft. Designers of condensers, radiators for evaporative systems, oil coolers to any specification, intercoolers and carburettor air heaters etc.

THE ANCILLARY INDUSTRY (CONTINUED)

236 BIRMINGHAM ELECTRIC FURNACES, LTD., Birlec Works, Tyburn Road, Erdington, Birmingham, 24 (East 1474).—Heat-treatment furnaces for ferrous and non-ferrous metals, including nitriding furnaces and furnaces for the heat-treatment of aluminium alloys, tools, etc.; direct and indirect arc melting furnaces for steel, iron and non-ferrous alloys.

237 HORDERN, MASON AND EDWARDS, LTD., Pype Hayes, Birmingham, 24 (Ashfield 1104/5).—High-grade blanking and raising presses with fixed and variable strokes, drawing presses, friction screw presses, guillotine shears, spinning, trimming and beading lathes, thread rolling machines, Bakelite moulding presses.

238 CAMBRIDGE INSTRUMENT CO., LTD., 13, Grosvenor Place, London, S.W.1 (Sloane 9140).—Aero-mixture indicators; air, oil and engine thermometers and pyrometers; accelerometers; air-speed recorders; vibrographs; research instruments, including wind tunnel balances, pilot testers, etc.

239 TITANINE, LIMITED, Colindale, London, N.W.9 (Colindale 8123).—Specialists in aircraft finishes, producing "Titanine" dope; schemes for the coating of fabric and plywood and for all forms of metal construction; approved suppliers of all finishing and protective coatings to the latest D.T.D. and B.S.I. specifications, these including a complete range of cellulose and synthetic finishes.

240 CELLACTITE AND BRITISH URALITE, LTD., Lincoln House, 296/302, High Holborn, London, W.C.1 (Holborn 5201 & 8824).—Cellactite unbreakable and incorrosible asbestos protected metal corrugated roof sheeting and roof ventilators; Uralite all-asbestos fireproof sheeting; Asbestone asbestos cement corrugated roof sheeting and flat sheeting to British Standards Specification; Urastone incorrosible flue pipes, ducting and fittings; Kimoloboard fireproof panelling with B.S.I. status for incombustibility and officially proved resistant to thermite in incendiary bombs.

241 LLEWELLYN RYLAND, LTD., Balsall Heath Works, Haden Street, Birmingham, 12 (Calthorpe 2284/5).—Specialists in the manufacture of lacquers, varnishes, enamels and all aircraft finishes, including "Duralac" jointing compound.

242 JAMES C. NICKLIN, LTD., Cross Street, Smethwick, Staffs (Smethwick 0805).—Stockholders of steel and aluminium alloys for the aircraft industry; exceptionally heavy stocks of sheets, tubes, rounds, hexagons and bars always carried. Orders despatched by return.

243 SIR ISAAC PITMAN AND SONS, LTD., Parker Street, Kingsway, London, W.C.2 (Holborn 3538).—Publishers of *Air Annual of the British Empire*, 1938 (21s.); *Handbook of Aeronautics* (new edition in 3 volumes—30s. net, 25s., and 20s.); *Pilot's "A" Licence* (Leeming, 3s. 6d.); and many other standard reference works and textbooks. New books include: *Aerodromes: Their Location, Operation and Design*, by Carl Pirath (10s. 6d.); *The Complete Air Navigator*, by D. C. T. Bennett, pilot of "Mercury" (15s. net); etc., etc.

244 AIRCO, LIMITED, Eagle House, 109, Jermyn Street, London, S.W.1 (Whitehall 8863).—Aviation factors, aircraft and engine sales. Sole representatives in Great Britain for B.G. plugs and accessories, *Interavia*, T.I. ignition screening harness, H.B.-type oil and petrol couplings.

245 W. T. FLATHER, LTD., Standard Steel Works, Sheffield (Attercliffe 41152).—Steels to Air Ministry specifications in bright drawn, turned or ground finish, also black rolled or hammered bars, supplied in "as rolled" or hardened and tempered state. Specifications: 2S2, 2S14, 4S11, 3S1, 2S21, 3S6, 3S15, D.T.D.126A, 32 Grades 1, 2, 4, D.T.D.176, S61, S80, D.T.D.299; many others in regular production.

246 AIRCRAFT MATERIALS, LTD., 104, Midland Road, London, N.W.1 (Euston 2508).—High-tensile alloy steel, duralumin, nickel alloy, bronze and all metals to Air Ministry specification in bar, sheet, tube and wire; shackles, fork joints, nuts, screws, rivets, A.G.S. parts and components; manufacturers of the "Aircraft" automatic riveter and high-speed-riveting equipment; patented "pop" rivet (approved by the Air Ministry), used where only one side of the structure is accessible.

247 BOULTON AND PAUL, LTD., Riverside Works, Norwich (Norwich 851).—Steel-framed hangars, airport buildings, aircraft factories, erecting shops, training schools, etc., both for home and export, and as already carried out for most of the leading aircraft concerns in the country.

248 FLETCHER MILLER, LTD., Hyde, near Manchester (Hyde 781/2).—Cutting oils, such as Cooledge (water soluble), Swift (sulphurised straight) and Swiftex (straight); Rodol rust preventives for inter-process and finished part protection. Approved suppliers of aero engine oil (A.M. spec. DTD 109), anti-freezing oil for controls (A.M. spec. DTD 44B), and anti-freezing grease (A.M. spec. DTD 143B). Full A.I.D. inspection.

249 NATIONAL BENZOLE COMPANY, LTD., Wellington House, Buckingham Gate, London, S.W.1 (Whitehall 7812).—Benzole, produced from coal at steel, iron and gasworks, giving quick response to throttle and having high volatility; available at many British aerodromes.

250 JOHN B. PILLIN, Church Hill, Beckenham, Kent (Beckenham 3434).—Aerodrome equipment, including "Jaybec" low-pressure oil pump for obviating compressed air in storage tanks; portable oiling units; oil and grease guns and sprays; air compressors, fixed and portable; air receivers; oil storage tanks with and without meters; dispensing towers; blow guns.

251 MERRIAM'S AVIATION BUREAU, 194, Above Bar Southampton (Southampton 2737).—Consultants and advisors; Employment Register, the Principal of which is Capt. F. Warren Merriam, A.F.C., A.F.R.Ae.S. (late R.A.F.), assisted by Sqn.-Ldr. B. K. D. Robertson, A.F.C., R.A.F. (retd.).

252 INTAVA, LTD., 50, Queen Anne's Gate, London, S.W.1 (Whitehall 5151).—Formed by the merging of the aviation interests of the Anglo-American Oil Co., Ltd., and the Vacuum Oil Co., Ltd.; marketers of Intava aviation fuels, oils, greases and special products, range covering all types of fuels and lubricants to meet the specifications set by aircraft constructors and Air Ministries throughout the world; service includes technical research, also a Carnet system whereby air tourists may obtain supplies of fuels and oils on credit terms.

253 BOSCH LIMITED, Larden Road, Acton, London, W.3 (Shepherd's Bush 2080) and 222, Bothwell Street, Glasgow, C.2 (Central 3154).—Sparking plugs, magnetos, coils, dynamos, windscreen wipers, searchlights and all electrical equipment.

254 STRAIGHT CORPORATION, LTD., 17, Manchester Square, London, W.1 (Welbeck 7455).—Operators of airports at Ramsgate, Ipswich, Exeter, Haldon, Plymouth, Weston-super-Mare, Swansea and Inverness, and controllers of Western Airways and Southern Airways; consultants in all branches of civil and military aerodrome siting, layout, zoning, construction, operation and management, with detailed knowledge of all Air Ministry and Ministry of Health requirements; also, maintenance, spray painting, and major overhauls and repairs on all types of civil aircraft and engines.

255 DART AIRCRAFT, LTD., 29, High Street North, Dunstable, Beds (Dunstable 429).—Aeroplanes and sailplanes to own designs; sub-contract and experimental work; historical aircraft; high-precision models for wind-tunnel work, etc.; repair and overhaul work.

256 BRITISH CELANESE, LTD., 22, Hanover Square, London, W.1 (Mayfair 8000).—Manufacturers of "Celastoid" for formed parts and fairings; "Novellon" clear sheeting for cut panels and formed parts; aeroplane dopes, tautening and identification; camouflage lacquers, etc.

One of the range of Exide aircraft batteries. (Para. 187.) (Right) Part of a 470,000 order for crankshaft forgings by The English Steel Corporation, Ltd. (Para. 3.)

THE ANCILLARY INDUSTRY (CONT.)

An S.U. carburettor, vertical type A.V.T. 25, as fitted to the Gipsy Twelve engine. A somewhat similar instrument is used on the Napier Dagger VIII engine. (Para. 42.)

257 E. HARRIS AND SON, Cope Street, Coventry (Coventry 60241/2).—Building and public works contractors; all classes of building, concrete, ground work and drainage; alterations and extensions to existing buildings; plumbing and decorating.

258 THE SKEFKO BALL BEARING CO., LTD., Luton (Luton 1100).—S.K.F. ball, cylindrical roller, taper roller and spherical roller bearings in standardised ranges, Air Ministry approved, of the various types and sizes required for all purposes in aircraft work; small light bearings developed specially for control positions; also supplied moulded into Bakelite pulleys of standardised dimensions suitable for carrying control cables.

259 GUEST, KEEN AND NETTLEFOLDS, LTD., Box No. 24, Heath Street, Birmingham (Smethwick 1121).—A.G.S. wood and metal thread screws, bolts and nuts, rivets, split pins, washers, hank rivet bushes; Nettlefolds-Parker-Kalon hardened self-tapping screws and screw-nails.

260 CONTROLLED HEAT AND AIR, LTD., 16, Grosvenor Place, London, S.W.1 (Sloane 9818).—Ovens for aluminium alloy ageing and general low-temperature tempering duties, etc. Conveyor and batch-type core-drying, enamelling ovens and equipment for all drying and heating processes; air conditioning, ventilation, etc.

261 AIRCRAFTINGS LIMITED, Power Road, London, W.4 (Chiswick 6470).—Petrol cocks, oil cocks, vacuum and air cocks, non-return valves, pressure-reducing valves, jettison valves and equipment, petrol filters, oil filters, petrol tank sumps with built-in cocks, oil tank sumps with built-in cocks, collector boxes and aircraft installed refuelling equipment, priming and supply pumps.

262 FEENY AND JOHNSON, LTD., 134/136, Ealing Road, Wembley (Wembley 4801/2).—"F. and J." universal hose clip, in steel strip and needing no special tool to attach; as supplied to War Office and used on aircraft.

263 CLYDE ALLOY STEEL CO., LTD., Craigneuk Works, Motherwell (Motherwell 357).—Alloy and stainless steels to Air Ministry, B.S.I. and private specifications in the form of billets, bars, forgings, etc. Alloy and stainless steel castings to any specification and survey, including turbine casings, pressure valves, bedplates and general engineering castings.

264 KIGASS, LTD., 19, Fitzroy Square, London, W.1 (Euston 5168).—Engine-starting devices, petrol mist injectors, atomisers, compressed and liquid gas equipment and cylinders for starting and running in all types of combustion engines; jets; fuel and oil filters; indicators, fuel economisers; jigs, tools and gauges.

265 TURNER MANUFACTURING CO., LTD., Wulfruna Works, Moorfield Road, Wolverhampton (Wolverhampton 21439). London Office: 19, Fitzroy Square, W.1 (Euston 5168).—Undercarriage oleos and tail units of pneumatic and oleo-pneumatic types; tricycle and ski undercarriages; oil-air high-pressure retracting mechanisms; vacuum pumps, fuel pumps, winch gears and aircraft components.

266 THE PALMER TYRE, LTD., Thames House, Millbank, London, S,W.1 (Victoria 8323).—Palmer tyres, wheels, brakes, gun-firing gear and rubber accessories, including inspection-hole covers, ammunition chutes, rudder bar ends (with toe-strap), rubber matting, etc. Tyres include high- and medium-pressure types and electrically conductive tail tyres; wheels of light alloy cast types. Brakes for operation by pneumatic or hydraulic pressure. Palmer gun-firing system associated with the Company's power hydraulic brake equipment.

267 THE NORTHERN RUBBER CO., LTD., Retford, Notts (Retford 256), and 45, Aldermanbury, London, E,C.1.—General rubber equipment and accessories. Sole manufacturers of "Nordoil" products. Synthetic rubber oil and petrol resisting compounds for joints, gaskets, sealing rings, connections, hose and tubing.

268 BRITISH ROLA CO., LTD., Minerva Road, Park Royal, London, N.W.10 (Willesden 4322).—Tool-making, jigboring, pressings, stampings and precision production items to Air Ministry or contractors' specifications.

269 LETTS QUIKREF DIARIES, LTD., 160, Shaftesbury Avenue, London, W.C.2 (Temple Bar 8421).—Diaries, including *The Airman's Diary*, containing 64 pages of useful information supplied by the Air Ministry; obtainable at all stationers, prices 1s. 6d. and 2s. 6d.

270 SMITH AND WELLSTOOD, LTD., 11, Ludgate Circus, London, E.C.4 (Central 3655). Head Office and Works: Bonnybridge, Stirlingshire.—Stoves, ranges, boilers and grates (for all kinds of solid fuel), as already largely used in aerodromes.

271 BURGESS PRODUCTS CO., LTD., Hinckley, Leicester; London Office, Thames House, Millbank, Westminster, S.W.1 (Victoria 2961).—"Acousti-Pad" quietening sheet, a sound-absorbent lining for wind tunnels, offices, engine cases, etc.; Burgess-Farnborough aero-engine silencers; air filters; Micro-switches for aeroplane controls; production meters; relays, etc., for all safety controls.

272 TANNOY PRODUCTS GUY R. FOUNTAIN, LTD., West Norwood, London, S.E.27 (Gipsy Hill 1131).—All branches of acoustic engineering, public address call systems for aerodromes, equipment for works installation, noise measurement apparatus, thermionic amplifiers for all purposes. Valveless power microphones and loud speakers for mobile tenders, loud speaking telephones.

273 D. LEWIS, LTD., 124, Great Portland Street, London, W.1 (Museum 4314).—Everything for aviation wear, including combination flying suits, fleece lined; sheepskin boots, lambswool lined; gloves, earphones, silk under-gloves, perfect-fitting goggles and helmets, etc.

274 A. WEST AND PARTNERS, 36, Broadway, Westminster, London, S.W.1 (Whitehall 5677).—All drawing-office equipment; photo-printing, drawing, tracing, photographic papers; "Uno" pen stencils and "Rectophot" rapid reproducer.

275 THE LIGHT PRODUCTION CO., LTD., 60/66, Rochester Row, Westminster, London, S.W.1 (Victoria 0671).—"Aerolite" pistons, die-cast in various alloys; "Cygnet" rings, made from centrifugally die-cast iron to various specifications, including Air Ministry 4.K.6 and other alloys, particularly alloy irons of nickel and chromium, also from Thermocrom (D.T.D. 233), developed and patented by the Company; new "Cellotin" anti-scuff rings; "R. and G." fluid measures—direct-reading magnetic gauges for storage tank contents.

276 HUNTERS OF CHESTER (James Hunter, Ltd.), Chester (Chester 754), Heston Airport (Hayes 410), and Portsmouth Airport (Portsmouth 5776).—Aerodrome preparation from virgin ground, utilising "Hunterising" processes, as used for Portsmouth Airport, Westland's Aerodrome at Yeovil, and Fairey's Great West Aerodrome; aerodrome surface maintenance and reconstruction in all its branches.

277 ALEXANDER, J. C., AND GARNER, J. C., Royal Exchange Arcade, Manchester, 2 (Blackfriars 6252/3/4).—Automobile agents and engineers; Packard distributors for Lancashire and parts of Derbyshire and Cheshire; agents for all leading makes.

278 FOX AND NICHOLL, LTD., Aircraft Department, Kingston By-Pass Road, near Surbiton, Surrey (Derwent 1122).—Aircraft sheet-metal workers, specialising in sub-assemblies, tools, jigs, shaped skins (including Alclad and duralumin), cowlings, fairings, latice ribs, wing tips, bulkheads, seats, air intakes, detail fittings, etc.

279 RANALAH, LTD., Morden Road, Merton, London, S W.19 (Liberty 2203/4/5/6).—Aircraft sheet metal work, drop hammer and presswork, aluminium and steel welding; specialists in radial engine cowls.

280 FIRTH - VICKERS STAINLESS STEELS, LTD., Staybrite Works, Sheffield (Sheffield 41193).—Manufacturers of high-tensile, non-corrodible steel sheets and strip for airframe plate fittings, high-tensile non-corrodible bars for machined fittings and non-corrodible steel rods for streamline wires and tie-rods; also manufacturers of valve steels and heat-resisting steels for exhaust manifold and collector rings.

281 YORKSHIRE ENGINEERING SUPPLIES, LTD., Upper Wortley Road, Wortley, Leeds (Armley 38234).—Specialists to the aircraft and motor industries. Sole producers and sellers of all alloys in phosphor bronzes and gun metals, cast by the "Eatonia" water-cooled process, in bars, castings or finished machined parts.

282 THE GENERAL FIRE APPLIANCE COMPANY, LTD., 11, Queen Victoria Street, London, E.C.4 (City 1799).—Manufacturers of fire engines, fire tenders, and foam, soda acid, methyl bromide and C.T.C. extinguishers; asbestos suits and all fire-fighting equipment for dealing with aircraft fires.

283 TUBAL CAIN FOUNDRY AND ENGINEERING WORKS (Proprietors, C. H. Bailey, Ltd.), Tyndall Street, Cardiff (Cardiff 6373/4).—Iron and non-ferrous castings of all descriptions and sizes.

284 CHARLES H. PUGH, LTD., Whitworth Works, Birmingham, 9 (Vic. 2524).—"Atco" motor mowers, accessories, power-propelled scythes and equipment for the maintenance of all areas of turf. Light pressings and high-class repetition work for the engineering trades.

285 SHORT AND MASON, LTD., Aneroid Works, Walthamstow, London, E.17 (Larkswood 3371/6).—Air-speed indicators and recorders, altigraphs, altimeters, aero compasses, revolution indicators, boost gauges, oil and fuel gauges, rate-of-climb indicators, oxygen regulators, undercarriage indicators, radiator thermometers, Brown turn-and-bank indicators, micro-barographs, various meteorological instruments and test apparatus.

286 ALEXANDER DUCKHAM AND CO., LTD., Duckham House, 16 and 18, Cannon Street, London, E.C.4 (City 6132).—Lubrication technologists—manufacturers of Duckham's Aero N.P.5 (aircraft engine lubricating oil) to Air Ministry specification D.T.D.109. Manufacturers of and suppliers to government departments and the aircraft industry of soluble and neat cutting oils, industrial oils and greases of every description, easing oil (for freeing refractory bolts, nuts, etc.), hand cleanser (as preventative of dermatitis) "Immutol Slush" and other preparations for protecting bright metal parts from rust and corrosion.

287 G. E. MORTLEY, SPRAGUE AND CO., LTD., Nelson Road, Tunbridge Wells (Tunbridge Wells 159).—Contractors to Admiralty, Air Ministry, Marconi's Wireless Telegraph Co., etc.; generators, wind- or engine-driven, for aircraft W/T.; rotary transformers, featherweight, with two, three or four commutators; H.T. motor generator sets; emergency hand-driven generators; pedal generators, etc.

288 THE POWER PLANT CO., LTD., West Drayton, Middlesex (West Drayton 2626).—All types of generated gears; gear generating machines; thread generating machines; cutters and hobs; standard double helical, bevel, spur and worm reducing and increasing gear units; all types of special gear boxes; change-speed units; aero gears; flexible couplings; magnetic clutches; gear hobbing machines; high-pressure pump units

289 THE ESSE COOKER CO. (Proprietors: Smith and Wellstood, Ltd.), 63, Conduit Street, London, W.1 (Central 3655). Head Office and Works: Bonnybridge, Stirlingshire.—Esse heat-storage cookers in great variety of size, also steam-cooking apparatus.

290 ELLISON INSULATIONS, LTD., Perry Barr, Birmingham, 20 (Birchfields 4554).—Tufnol, a non-metallic, laminated material, half the weight of aluminium, a grade 1 electrical insulator, and produced in sheets, tubes, rods, bars, angles and channels in eight brands, with tensile strengths from 2 to 7 tons/sq. in.—as used in aircraft for pulleys, fairleads, petrol pump valves, radio lead-in tubes, etc.

291 THE BROOKE TOOL MANUFACTURING CO., LTD., Warwick Road, Greet, Birmingham, 11 (Victoria 2235/6/7).—Manufacturers of all classes of small tools, milling cutters, counterbores, reamers, twist drills, saws, drill chucks, machine vices, tapping attachments, geared pumps, gauges, ground-thread taps, jigs, fixtures and similar machine-shop equipment; accurate machined parts of all types, approved for inspection and release.

292 NISSEN BUILDINGS, LTD., Rye House, Hoddesdon, Herts (Hoddesdon 3001/2).—Factories and extensions; hangars, shops, stores, canteens, cycle sheds, air-raid shelters, cleansing and first-aid stations.

293 COOKE, TROUGHTON AND SIMMS, LTD., York (York 4112).—Surveying instruments for aerodrome construction—theodolites, levels, etc.; inspection instruments for aircraft factories—Vickers projection microscope, Vickers contour projector, bench microscopes, optical comparator.

294 AUTOMOTIVE ENGINEERING CO., LTD., The Green, Twickenham, Middlesex (Popesgrove 2206).—Petrol and oil engine pistons; patented design of retaining rings, the Seeger; gravity sand and die castings in Air Ministry specification materials; collets and feed fingers for all types of automatics and capstan lathes; circular-form tools for automatics and capstan lathes; patented ball-end tappet adjusting screws.

295 D. H. BONNELLA AND SON, SON, LTD., 46-48, Osnaburgh Street, London, N.W.1 (Euston 4211).—Manufacturers of "Bonnella" aircraft electrical equipment and accessories to Air Ministry design. Switchboxes, dimmer switches, terminal blocks, lamps, accumulator cut-outs, etc. A.G.S. parts Nos. 1,500 upwards; moulders in bakelite from moulds made in own works; turners in all metals, wood, ivory, ebonite, etc. Sole selling agents for Handley Page electrical bomb release gear.

296 TECHNICAL IMPROVEMENTS, LTD., Wansey Works, London, S.E.17 (Rodney 4363).—Ignition screening apparatus for aircraft or other engines, ignition wiring, plug elbows, pipe clips, oil-pipe couplings for low- or high-temperature oil.

297 ROTHERHAM AND SONS, LTD., Spon Street, Coventry (Coventry 4154).—Manufacturers of A.G.S. parts in brass and duralumin; oil pumps for aircraft engines; special parts for aircraft to manufacturers' own specifications; pressure-gauge movements; small gear wheels; general precision work.

298 DECCA RADIO AND TELEVISION, LTD., 1-3, Brixton Road, London, S.W.9 (Reliance 3311).—Ozonisers, aerators, air-filtration units; poison gas filters and poison gas absorption apparatus; replaceable gas absorption cylinders; electric and manual poison-gas filtration units for sealed A.R.P. rooms, cellars and underground shelters.

299 ROBERT KEARSLEY AND CO., Ripon, Yorks (Ripon 415/6).—"Nulac" synthetic resin varnishes and enamels for all-metal aircraft (brushing and spraying), Kearsley's factory floor paint and Kearsley's white line paint, also paint for A.R.P. purposes

300 HAMMOND PUMP AND EQUIPMENT CO., LTD., Kingsbury Works, Kingsbury Road, London, N.W.9 (Colindale 8861).—Petrol, fuel oil and lubricating oil, electrically operated metering columns for aerodromes.

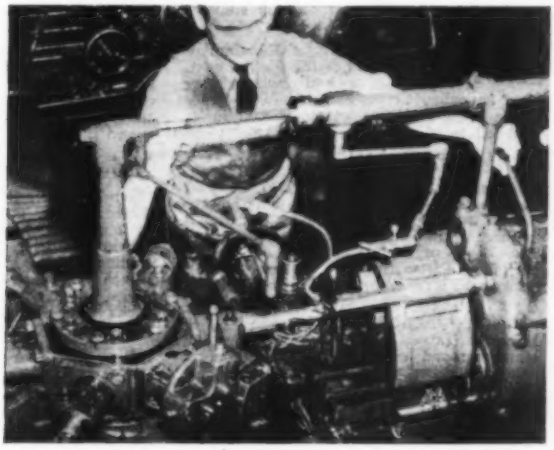
301 ALBION DROP FORGINGS CO., LTD., Foleshill, Coventry (Coventry 8091).—Drop forgings in carbon and alloy steels and non-ferrous metals for aircraft, aero engines and automobiles. On Air Ministry approved list.

302 BRIAN ALLEN AVIATION, LTD., Airport of London, Croydon (Croydon 0031/2).—Suppliers of all types of aircraft, new and used. Sole English distributors for Stinson aircraft. Distributors for the South of England for Tipsy aircraft. All types of aerial photography.

303 METALECTRIC FURNACES, LTD., Cornwall Road, Smethwick, Birmingham (Smethwick 1561).—Electric furnaces and equipment, including salt baths for the treatment of aluminium alloys; aluminium melting furnaces, continuous billet-heating plant, recirculated atmosphere furnaces for annealing aluminium; carburising and reheating furnaces for aero engine parts, electrically operated furnace — charging machines.

304 M.R.C., LTD., Teleflex Works, Chadwell Heath, Essex (Seven Kings 4566).—Makers of Teleflex push-pull controls (to operate throttles, constant-speed and two-pitch airscrew controls, landing lights, wireless, fuel cocks, indicators, etc), and Teleflex patented cable, embodying a raised helix and used to actuate rotary movements as well as all lever movements

One nine-cell unit, Type AMS5 of a twelve-volt NIFE starter battery, two of which are fitted in each Empire flying boat. (Batteries, Ltd.—Para. 233.)



Machining high-tensile stainless steel for an aircraft undercarriage with "Swift" sulphurised straight-cutting oil, made by Fletcher Miller, Ltd. (Para. 248).

THE ANCILLARY INDUSTRY (CONTINUED)

305 THE TELEGRAPH CONDENSER CO., LTD., North Acton, London W.3 (Acorn 0061).—T.C.C. condensers for aircraft transmitters and receivers; ignition condensers for special duty and for radio interference suppression.

306 AIRPORTS, LTD., Gatwick Airport, Horley, Surrey (Crawley 555). Also at Gravesend Airport, Kent (Gravesend 1400).—Aerodrome owners; civil and military aircraft operators; approved by the Air Ministry for the manufacture of aircraft parts and components under A.M. Form 705; civil aircraft repairs and engine overhauls; lock-ups for private owners at Gatwick. Operators of Elementary and Reserve Flying Training Schools at Gatwick and Gravesend Airports.

307 OLDHAM AND SON LIMITED, Denton, Manchester (Denton 2431). Manufacturers of cells, accumulators and batteries suitable to meet all aircraft requirements.

308 FLEXIBLE SHAFT MANUFACTURING CO., Town Road, Edmonton, N.9 (Tottenham 3541).—Flexible drives for instruments, remote controls, cameras, etc.; complete flexible-shaft equipments for engineers, for grinding, filing, fettling, disc grinding, drilling, etc.

309 SPECIALLOID, LTD., Friern Park, North Finchley, London, N.12 (Hillside 2233).—Aero engine pistons from Specialloid new-process castings or from forged blanks in various alloys according to requirements. Complete facilities for machining all types of aero engine pistons; approved contractors to the leading British manufacturers.

310 THE BRITISH OXYGEN COMPANY, LTD., Thames House, Millbank, London, S.W.1 (Victoria 8477).—Oxy-acetylene welding equipment and accessories; oxy-acetylene and oxy-coal-gas equipment for hand or machine cutting of steel; welding rods and fluxes suitable for all weldable metals and alloys; dissolved acetylene flarelights for emergency lighting.

311 J. PENNY AND SON, Steel House, Oldbury, Birmingham (Broadwell 1621/2).—Stockists of all aircraft specification steels, in sheets, bars, strip and wire; stainless steel in all forms, for machining, forging and pressing, etc., and full range of aluminium sheets; suppliers to principal aircraft firms and their sub-contractors.

312 INGERSOLL-RAND COMPANY, LTD., 165, Queen Victoria Street, London, E.C.4 (Central 5681).—Portable and stationary air compressors for operating rock drills, concrete breakers, pneumatic tools and paint-spraying equipment; units available for electric, petrol or oil engines, and belt drive from shafting.

313 L. CAMERON AND SON, Camloy Works, Sheffield, 1 (Sheffield 22725). —Camloy non-corrosive and heat-resisting alloy for exhaust pipes and manifolds, easily cold worked and resistant to special fuels; supplied to specification D.T.D. 316.

314 F. HILLS AND SONS, LTD., Trafford Park Road, Trafford Park, Manchester, 17 (Trafford 1894).—Makers of Tego bonded plywood, laminated and improved wood for wing-spars, etc.; design and factory equipment for mass-production of any type of wood construction; small machined parts, cowlings, spinners, etc.; design and manufacture of light aircraft.

315 BRADSHAW BROS. (CONTRACTORS), LTD., 214, Blackbird Road, Leicester (Leicester 65134).—Aerodrome and landing-ground contractors—constructors of a large number of the aerodromes in Great Britain; patentees of the latest gravel-filled drainage, successfully used by the Air Ministry

316 BRITISH ENGRAVING AND NAMEPLATE MANUFACTURING CO., 7-8, Charlotte Mews, London, W.1 (Museum 8162).—Nameplates in all metals and plastic materials (e.g., Perspex); indicator and scientific instrument makers for aircraft, etc.; machine engraving on contractors' parts.

317 J. F. RATCLIFF (METALS), LTD., New Summer Street, Birmingham (Aston Cross 3576/7).—Rolled metals (Luster); brass, cartridge metal, copper, phosphor bronze, naval brass, gilding metal, etc., in strip or sheet, 0.001in. thick and upwards. Supplied in all tempers to Air Ministry specification.

318 THE AERONAUTICAL AND PANEL PLYWOOD CO., LTD., 218/226, Kingsland Road, London, E.2 (Bishopsgate 5641).—Manufacturers of plywood for all aeronautical purposes; shaped components; compressed wood; balsa-filled plywood; metal-faced plywood; all sizes and thicknesses, and panels scarf-jointed to any length.

319 THE R.F.D. CO., LTD., 17, Stoke Road, Guildford, Surrey (Guildford 3232/3).—Makers of all kinds of kite balloons; flotation gear for aircraft and seaplanes; pneumatic dinghies for life-saving in aircraft and seaplanes; pneumatic motor dinghies for tender work in connection with seaplanes, etc.; flag and drogue targets; wind socks; rigid containers for aeroplane flotation, etc.

320 LACY-HULBERT AND CO., LTD., Boreas Works, Beddington, Nr. Croydon, Surrey (Croydon 5504/5/6).—Air compressors, vacuum pumps, machines for testing pneumatic firing gear, paint and camouflage spraying apparatus, complete compressed-air installations.

321 WILLIAM MILLS, LTD., Grove Street, Birmingham, 18 (Smethwick 1156/7/8).—Castings in aluminium and light alloys and aluminium bronze; sand castings and die castings.

322 T. M. BIRKETT AND SONS, LTD., Hanley.—Non-ferrous castings in all metals, chill-cast phosphor bronze rod, machined bushes, all to Air Ministry specifications.

323 W. S. SHACKLETON, LTD., 175, Piccadilly, London, W.1 (Regent 2448/9).—Aeronautical consulting engineers and merchants. Suppliers of all types of new and used aircraft, engines and all aeronautical and engineering accessories to operating companies and private owners in England and throughout the world. British representatives, consultants and buyers to a large number of firms throughout the world. Aeroplanes bought, sold and exchanged. Packing, shipment and insurance arranged to any destination. Test flying, inspection reports and technical consulting on all aeronautical subjects.

324 HENRY BROWNE AND SON, LTD., Station Works, Barking, Essex (Rippleway 3113/4).—Air Ministry contractors; "Sestrel" aircraft compasses of all types and accessories, as used on many record flights.

325 TIMMINS AND CO., LTD., 83/85, Wellington Street, Slough, Bucks (Slough 1098).—Manufacturers of metal thread screws, nuts, bolts, terminals, etc., by high-speed automatic screw machinery; turned repetition parts in all metals, including stainless steel. Specialists in A.G.S. turned parts, e.g., screws, bolts, nuts, turned rivets, nipples, tank bolts, and tank dipsticks, turned washers and any special machined parts to blue-print.

326 HIGH DUTY ALLOYS, LTD., Buckingham Avenue, Trading Estate, Slough (Slough 21201).—Manufacturers of the "Hiduminium" series of high-tensile aluminium alloys, supplied in all cast and wrought forms, including extruded sections, drawn tubes and rolled sheet; castings, stampings, and extruded sections as used extensively on every British aero engine and aeroplane in production.

327 MAGNESIUM CASTINGS AND PRODUCTS, LTD., Buckingham Avenue, Trading Estate, Slough (Slough 21201).—Manufacturers of the "Magnuminium" series of magnesium-base alloys to all D.T.D. specifications, supplied in the form of sand and die castings, extruded and drawn tube and sections, rolled sheet, and a recent development successfully applied to the production of airscrew blades—in wrought forms.

328 G. BEATON AND SON, LIMITED, Victoria Road, Willesden, London, N.W.10 (Willesden 3540, 6 lines).—Airframe components, including mainplanes, screens, ailerons, elevators, tailplanes, etc.

329 KURT ERLACH, LTD., Volspray Works, Cray Road, Sidcup, Kent (Footscray 2282/3/4).—Spray painting, air compressor and allied equipment manufacturers. Contractors for portable spray painting equipment to the Air Ministry. Exhaust fans and ventilating equipment. Plant for spraying of camouflage paint.

330 S. LEWIS, 27, Carburton Street, London, W.1.—Makers of flying clothing, including many types of suits, jackets, flying boots, helmets, gloves, goggles of many varieties, including standard R.A.F. pattern; complete Civil Air Guard outfits.

331 FLIGHT REFUELLING, LIMITED, Ford Aerodrome, Arundel, Sussex (Yapton 274/5).—Flight refuelling aircraft engineers; manufacturers of flight refuelling equipment; modification of aircraft for the reception of refuelling; designers and construction of aircraft tankers; promoters of flight refuelling development and organisers of services, etc.

332 ARENS CONTROLS, LTD., Tunstall Road, East Croydon, Surrey (Works and offices, Addiscombe 3051/4).—Specialists in mechanical remote control installations, adapted to engine, flying and indicator controls, petrol cocks, flaps, landing lamps, etc.

333 J. B. STONE AND CO., LTD., Finsbury Pavement, London, E.C.2 (National 8695).—Patent nibbling machines for quickly cutting all kinds of shapes from sheet metal; "Heavy Drive" conveyor and heavy transmission belt fasteners, flexible steel belt lacings; drilling machines, sanders, circular sawing machines, Procunier tappers, belt cutters, engineers' tools and supplies.

334 DUREX ABRASIVES, LTD., Arden Road, Adderley Park, Birmingham, 8 (East 1605).—Manufacturers of complete range of coated abrasive products and pressure-sensitive adhesive tapes for aircraft production purposes.

335 THE GLEDHILL-BROOK TIME RECORDERS, LTD., Empire Works, Huddersfield, Yorks (Huddersfield 3543).—Time recorders, mechanically and electrically propelled; time checking, job costing and wage-paying systems; time and cost cards; wage-paying racks.

336 THE LISSON AIRCRAFT AND PRECISION ENGINEERING CO., LTD., 103, Farnham Road, Slough (Slough 22263/4).—Nuts, bolts, washers, pins and A.G.S. parts to Air Ministry specifications and to manufacturers' special requirements.

337 ROLEX WATCH CO., LTD., 40-44, Holborn Viaduct, London, E.C.1 —"Rolex" Oyster watches, as used by F/O. Clouston and members of Houston Everest Expedition; waterproof, dustproof, climate-proof and anti-magnetic.

338 BENDIX LIMITED, Tyseley, Birmingham (Acocks Green 1601).—Aircraft brakes, differential gear and controls, mechanical, pneumatic and hydraulic; constant-velocity universal joints; vacuum control gear; aircraft brake-testing machines; control cables for aircraft work.

339 S. G. BROWN, LTD., Victoria Road, North Acton, London, W.3 (Acorn 1174).—Headphones for aircraft; monophones for inter-cockpit communication; special models to fit flying helmets; all types of Brown headphones serviced.

340 SMITH'S STAMPING WORKS (COVENTRY), LTD., Ribble Road, Coventry (Coventry 3151).—Drop forgings in steel and light alloys to all standard specifications, with full heat treatment and testing.

341 SIMMONDS AEROCESSORIES, LTD., Great West Road, Brentford (Ealing 2212/6).—Simmonds Elastic Stop-Nut, Simmonds-Corsey (push-pull) controls, Simmonds-Goudine navigational instruments, Simmonds electric and hydraulic contents gauges and flap and undercarriage indicators, Simmonds cowling clips, Simmonds jointing compound, Simmonds pipe coupling, Wondergrip non-slip flooring. New subsidiary company, Simmonds Aerocessories (Western) Ltd., now in production at Cardiff.

342 THE CLEVELAND BRIDGE AND ENGINEERING COMPANY, LTD., Darlington (Darlington 2710).—Hangars and steel buildings, Eclair counterbalanced doors for hangars and factories.

343 REID AND SIGRIST, LTD., Shannon Corner, Kingston By-pass, New Malden (Malden 3272/5).—Turn indicators: Two-needle model standard in the Royal Air Force; bubble type for light planes, commercial use. Gyorizon, turn indicator in picture with visible horizon effect. Fore-and-aft levels, standard in the Royal Air Force. Fire-fighting hook for aerodromes and A.R.P. use. Aircraft picket. Pilot-testing and training apparatus, for eliminating those likely to become bad pilots and training others.

344 THE BRITISH PISTON RING CO., LTD., Holbrook Lane, Coventry (Coventry 8014/5/6).—Wide range of piston ring materials for aircraft engines with tensile values up to 60 tons/sq. in.; special plant for manufacture of taper-sided rings. Centrifugal foundry producing cylinder barrels and sleeves in various materials. Two subsidiaries, C.M.D. Engineering Co., Ltd., Warwick, and British Aero Components, Ltd., Coventry, specialising respectively on pistons and gudgeon pins and on aircraft valves of all types, stellited, nitrided and sodium-filled, under Wilcox Rich Corporation (U.S.A.) patents.

345 J. STONE AND CO., LTD., Deptford and Charlton, London, S.E. (Tideway 1202).—Voltage regulators—carbon pile type, to Air Ministry specification. Non-ferrous alloy castings, die-castings, forgings, stampings and extrusions, including "Ceralumin" high tensile aluminium alloys (D.T.D.250, 255, 287, 293) and Superston L.189 aluminium bronze (D.T.D.197). "Elektron" magnesium alloys, castings and die-castings (D.T.D.59A, 136A, 281, 285, 289). Chromium bronze bearing alloys (D.T.D.-354) Rivets and washers in duralumin, aluminium, copper, stainless steel, etc., to Air Ministry specifications.

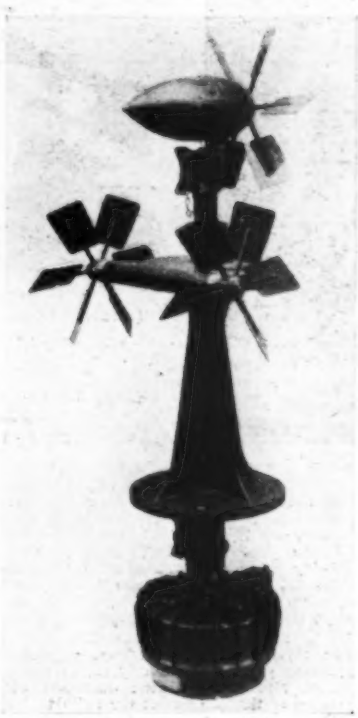
346 LOUIS BAMBERGER AND SONS, 27-28, Finsbury Square, London, E.C.2 (National 8502).—Importers of aero-quality silver spruce in a very varied range of grades and sizes; mahogany, birch and ash. Suppliers of 4V3 plywood and aircraft-quality spruce veneers.

347 J. V. W. CORPORATION, LTD., 30, Chester Street, S.W.1 (Sloane 1136).—Contractors to H.M. and Dominion Governments; suppliers, etc., of the Link Trainer (for blind-flying and blind-landing instruction) to the British Empire, Egypt, Iraq, Iran and Siam. Associated Companies, J. V. W. Corporation, Newark, New Jersey, U.S.A.; Link Aviation Devices, Binghamton, New York; and Link Manufacturing Co., Ltd., Gananoque, Ontario.

348 R. AND J. PARK, LTD., 143-9, Fenchurch Street, London, E.C.3 (Mansion House 3083).—Specialists in collecting, packing and shipping complete aircraft and parts to any part of the world.

349 CHAMIER, GILBERT-LODGE AND CO., Aldwych House, Aldwych, W.C.2.—Aerodrome and general aviation consultants; drafting machines and plotters; importers and exporters of aircraft and engine accessories; branches throughout Australia and New Zealand.

THE ANCILLARY INDUSTRY (CONT.)



Transmitting unit of an aerodrome windspeed- and direction-indicating apparatus by Elliott Bros. (London) Ltd. (Para. 203.)

350 BROCKHOUSE ENGINEERING (SOUTHPORT), LTD., Crossens, Southport, Lancashire (Southport 87101).—General machining, gear-cutting and grinding of aircraft and aero engine components in all metals. Airframe sheet-metal work and sub-assemblies. Arc welding, spot welding and welding of light alloys. Special light alloy pressings. Complete fuel tanks of various types. Complete gun turrets. Road vehicle body construction to A.M. specifications. Approved under A.M. Form 705, and A.N.D.

351 BARNET INSTRUMENTS, LTD., Bath Place, Barnet, Herts (Barnet 4380).—Patent boost gauges and air, oil, fuel, suction and pressure gauges for aircraft; all types of pressure gauges for ground equipment; gauges and regulators for oxy-acetylene welding; pressure-gauge testing equipment.

352 HORSELEY BRIDGE AND THOMAS PIGGOTT, LTD., Tipton, Staffs (Tipton 1104), and 22, Carlisle Place, London, S.W.1 (Victoria 4063).—"Lamella" (patented) steel roof construction for hangars and all buildings having large clear spans; structural steelwork; pressed-steel tanks; riveted and welded tanks and vessels; iron castings; water softening and purification plant.

353 FERRANTI, LTD., Hollinwood, Lancs (Failsworth 2000), and Bush House, London, W.C.2 (Temple Bar 6666).—Aircraft and electrical instruments; engine and air-speed indicators; engine cylinder thermometers; gyroscopic turn-and-bank indicators; direct-operated oil, air and fuel pressure gauges, and transmitting-type fuel gauges; moving-coil and thermo-ammeters, milliammeters and voltmeters. Other instruments in course of development. Small parts for aircraft use—bolts, pins, etc.—and mouldings.

354 JAMES ARCHDALE AND COMPANY, LIMITED, Ledsam, Street, Birmingham, 16 (Edgbaston 2276).—Radial, vertical and multiple-spindle drilling machines; plain horizontal and vertical milling machines; thread-milling machines; suitable for producing aero components, airframe sections, etc.

355 SILENTBLOC, LTD., Victoria Gardens, London, W.11 (Park 9821).—Anti-vibration engine mountings of several types designed for aircraft work, with rubber is stretched between concentric tubes preserving it from deterioration; special mountings for exhaust rings and instrument boards; equipment for individual instruments, ranging from fittings designed to support only a few ounces to others of much larger size. Flexible couplings also supplied.

356 GIEVES, LTD., 21, Old Bond Street, London, W.1 (Regent 6411).—Royal Air Force and other uniforms; "Everest" flying suit, as originally designed for Houston Everest expedition; white or blue zip-fastened overalls; leather and canvas helmets; gloves, etc.

357 LONDON ALUMINIUM COMPANY, LTD., Witton, Birmingham, 6 (East 1156).—Manufacturers of special plant and equipment in aluminium and aluminium alloys; spinning (maximum diameter 6in.); aircraft sheet metal work, pressing, stamping; anodic treatment (Bengough Stuart and "Brytal" processes); specialists in prototype aircraft work; productions include petrol tanks, oil tanks, cowlings, reflectors, wheel spats, venturi tubes, aero type mandrels.

358 E.R. PLUGS, LTD., Regamoid Works, Angel Road, Edmonton, London, N.18 (Tottenham 3605).—Manufacturers of sparking plugs for aero engines.

359 ACCLES AND POLLOCK, LTD., Oldbury, Birmingham (Broadwell 1500).—Makers of steel, alloy steel and stainless steel tubes to aircraft specifications. Specialists in manipulation of tubes and welding into complete structures; special finished oleo-leg work; cylinder and plunger tubes for all hydraulic, electraulic and air-draulic systems. Capillary and small tubes from 0.001 in. bore and 0.005 in. o/d. in all metals. Makers and manipulations of cold-rolled metal sections.

360 V.D.M. SPINNERS, LTD., Wharf Street, Warwick (Warwick 501).—Quick-detachable spinners or nosings; cowlings, sheet-metal aircraft components.

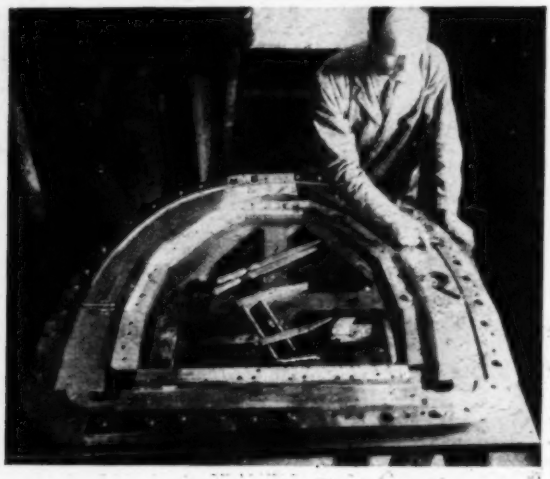
361 JOHN MARSTON, LTD., Wolverhampton (Wolverhampton 21481).—Aircraft radiators, R.A.E. and other oil coolers, cabin heating systems, tanks, machined fittings and assemblies, oleo shock absorber units and hydraulic equipment, gun mountings, general sheet-metal work.

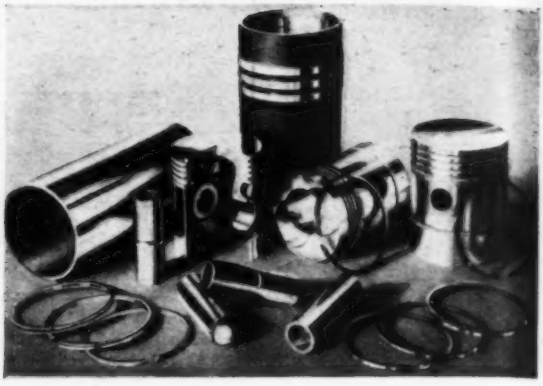
362 SIMPLIFIX COUPLINGS, LTD., Head Office: 3, Victoria Street, London, S.W.1 (Abbey 3592). Works: Manchester.—Joints for copper tube, duralumin and D.T.D. 310 light alloy tube. Sole manufacturers of the "310 Joint" (evolved for soft alloy tubes, in co-operation with Air Ministry, and now in production; interchangeable with standard A.G.S. parts), and the improved "Simplifix" joint, approved for all services by Air Ministry for R.A.F. and civil aircraft.

363 LISSEN, LTD., Angel Road, Edmonton, N.18 (Tottenham 3040).—A.G.S. parts, general machining, repetition work to A.L.D. requirements, including Bakelite and plastic moulding; small aircraft electrical parts and assemblies, including relays, charge regulating switches, terminal blocks, junction boxes, ignition switches, etc.

364 EXCELSIOR MOTOR RADIATOR CO., LTD., 49-59, Armley Road, Leeds (Leeds-Armley 38081).—Radiators, oil coolers, tanks, air intakes, windscreens, fairings, cockpit doors, skin fillets, and general sheet-metal work.

THE ANCILLARY INDUSTRY (CONTINUED)





(Above) Pistons, rings, cylinder liners and gudgeon pins by Hepworth and Grandage, Ltd. (Para. 158.)

(Left) An aircraft press tool in course of construction at the works of Cornercroft, Ltd. (Para. 17.)

365 BREEZE CORPORATION OF GREAT BRITAIN, LTD., Vicarage Lane, Ilford, Essex (Ilford 1551).—Specialists in design and supply of all electrical screening accessories, ignition harness for aircraft, marine and motor engines. Suppliers of various types of aircraft controls, flexible drives and fuel analysers.

366 YOUNG ACCUMULATOR CO., LTD., Malden Way, New Malden, Surrey (Malden 2484).—Manufacturers of lead-acid batteries for ground starting, wireless, navigation lights and all aviation purposes.

367 LAYSTALL ENGINEERING CO., LTD., Ewer Street, Southwark, London, S.E.1 (Waterloo 6141).—Crankshafts, camshafts, Nitralloy steel cylinders and liners; cylinder and crankshaft regrinding; nitriding and general engineering precision work, comprising practically every class of machining and grinding operation.

368 POLES (1938) LTD., Nickel Works, Tyburn Road, Erdington, Birmingham (Erdington 1616).—"Adastra" sectional steel standards for aerodrome obstruction lights, radio aerials, etc., for ground planting or erection on buildings; in heights up to 200ft.;

369 CONSTRUCTORS, LTD., Nickel Works, Tyburn Road, Erdington, Birmingham (Erdington 1616).—"Adjusteel" shelving, quickly erected and easily adjusted to meet all storage requirements. Works equipment, including racks, steel "Arc" work benches, tool stands and cupboards, bench trestles. Cycle parks, affording complete protection, available in a variety of designs. Lockers for safe and hygienic accommodation of workers' clothes. Steel office furniture, including filing cabinets, desks, tables and cupboards.

370 AVIMO, LTD., Taunton, Somerset (Taunton 2104).—Accessories for aero engines: carburettors, starters, high-pressure pipe couplings, flame traps, sand traps, exhaust flame dampers, screened harness. Accessories for aircraft: pressure heads, oxygen equipment, control dampers, airscrew brakes. British manufacturing rights for all Bronzavia products.

371 GALLAY, LTD., Edgware Road, Cricklewood, London, N.W.2 (Gladstone 2201) and 103-109, Scrubs Lane, Willesden, London, N.W.10 (Willesden 3911).—Radiators for liquid-cooled engines, incorporating Gallay System "E" cooling element in cupro-nickel for ethylene glycol, and System "G" for pressure water. Dual-stage oil coolers with non-freezing tube element. Coolers for hydraulic systems. Steam heating and air-conditioning equipment for cabins, as fitted to latest military and civil aircraft. Fireproof and bullet-proof fuel tanks. Sheet-metal work of all kinds. Prototype and experimental work.

372 TROUGHTON AND YOUNG, LTD., 143, Knightsbridge, London, S.W.1 (Kensington 8881).—Electrical engineers and contractors for wiring of aerodromes and factories—on Air Ministry list; also designers and manufacturers of electric lighting fittings; registered designers and patentees of "Ultralux" and "Louverlux" lighting.

373 K.L.G. SPARKING PLUGS, LTD., Putney Vale, London, S.W.15 (Putney 2671).—Sole manufacturers of K.L.G. sparking plugs for aero engines, in 12mm., 14mm. and 18mm. thread diameters with reaches of thread to meet the individual requirements of British, Continental and American motors for both military and civil purposes. Plugs in standard unscreened form with suitable terminal connections for H.T. lead fittings employed on different engines; alternative models, denoted by the prefiex letter "R," to provide an integrally screened version. Fully approved by Air Ministry. Also manufacturers of a complete range of screening equipment.

374 JICWOOD, LTD., Weybridge, Surrey (Weybridge 1600/1).—"Jicwood" compressed wood for airscrew blades; "Jicwood" impregnated wood for general aircraft and other purposes.

375 PORTSMOUTH, SOUTHSEA AND ISLE OF WIGHT AVIATION, LTD., The Airport, Portsmouth (Portsmouth 74374).—Airline and charter operators. Aircraft overhaul, repairs and construction to order. Day and night army co-operation flying for the Air Ministry.

376 AERASPRAY MANUFACTURING CO., LTD., Thimble Mill Lane, Birmingham, 7 (East 1671).—Air compressors of advanced design and suitable for all purposes; machines single or two-stage, air or water-cooled. Available in sizes from 2 to 600 cu. ft./min. displacement. Complete dope-shop installations and fume exhaust systems for every purpose connected with the aircraft industry. "Aerospray" guns (fast working and fine atomisation), for gravity, suction or pressure feed. Portable spraying plants for service work.

377 TECALEMIT, LTD., Great West Road, Brentford, Middx (Ealing 6661).—Manufacturers of aircraft and aerodrome equipment, including hydraulic pumps and motors for operating gun turrets, retractable undercarriages and other services requiring single or twin units rotating in either direction with constant and pulsation-free delivery; mechanically operated fuel pumps; lubricating and fuel oil cleaners; high-pressure lubricating systems; liquid meters of positive displacement and ± 0.2 per cent. accuracy for fuel handling, etc.; automatic safety refuelling nozzles; air compressors; washing plant and a wide range of ground servicing equipment.

378 WORLDWIN PISTONS, LTD., Treforest Trading Estate, Glam (Taffs Well 118).—"Worldwin" aluminium alloy pistons for aircraft engines, with patented web construction connecting crown, walls and gudgeon-pin bosses; manufactured in approved materials for semi-die castings. Also gudgeon-pin manufacture.

379 GAMBRELL RADIO COMMUNICATIONS (Proprietors, Rediffusion, Ltd.), Broomhill Road, Wandsworth, S.W.18 (Putney 5691).—Military radio communication equipment; marine radio telegraph and telephone equipments—aerodrome direction-finder equipment.

380 STERNOL, LTD., Royal London House, E.C.2 (National 7644).—Sternopal cutting fluid for all general machining operations; Tapoyl straight cutting oils for the machining of Monel metal, Air Ministry and all stainless steels; Kwenchoyl for general and cyanide heat treatment; Protexon D.T.D.121.C rust preventative for the coating of aircraft spares; Sternocleanse antiseptic cream for the protection of workers against dermatitis.

381 HENRY PELS AND CO., LTD., 32, Osnaburgh Street, London, N.W.1 (Euston 4113).—Folding presses (press brakes), nibblers and guillotines with draw-cut, as supplied to practically all important aircraft manufacturers; made solely of rolled armour plates of high tensile and elongation; frames permanently guaranteed.

382 KILFROST MANUFACTURING CO., LTD., Albion Works, Balfe Street, London, N.1 (Terminus 3462).—Manufacturers of Air Ministry approved deicing paste.

383 THE BESSBROOK SPINNING CO., LTD., 15, Aldersgate Street, London, E.C.1 (National 6226). Mill and factory at Bessbrook, Co. Armagh, Northern Ireland).—Manufacturers from the raw flax to the finished cloth of aero linen fabric to Air Ministry Specification 6.F.1.

384 THE MOLLART ENGINEERING CO., LTD., Kingston By-Pass, Surbiton, Surrey (Elmbridge 3352/3/4).—Sole patentees and manufacturers of the M.F. patent universal ball joint, extensively used in military and civil aircraft construction. Manufacturers of precision components and sub-assemblies for the industry. Precision jigs, tools, combination gauges, plain plug and ring gauges, screw plug and screw ring gauges to Air Ministry limits.—Air Ministry Approved Gauge Test House, Authority No. 89755/31. Jig boring; sand blasting; heat treatment. Precision moulders for aircraft components in approved materials.

385 THOMAS GREEN AND SON, LTD., Smithfield Iron Works, Leeds, 2 (Leeds 20357) and New Surrey Works, Southwark Street, London, S.E.1

(Waterloo 4301).—Manufacturers of Green's gang mowers, as supplied to the Air Ministry, fitted for either horse or motor traction. Also heavy and light motor mowers; rollers for grass and asphalt; all sizes of petrol-driven and hand-propelled mowers for fine lawns, including the non-rib Silens Messor de Luxe.

386 BELL'S ASBESTOS AND ENGINEERING SUPPLIES, LTD., Slough, Bucks (Slough 830).—"Bestobell" Air Ministry pattern fire-fighting clothing; asbestos flying suits, helmets, gloves and boots; isolation screens for aircraft hangars and parks; specialists in insulation of all types of cabin-heating appliances; coloured asbestos fabrics for aircraft upholstery; sound- and fire-insulating materials for engine and cabin bulkheads.

387 DIECASTINGS, LTD., Highgate Square, Birmingham, 12 (Calthorpe 2335).—Specialists in the manufacture of aluminium-alloy (gravity) die-castings for aircraft components, airframes and aero engines On A.I.D. lists for inspection and release. Specification alloys used.

388 TURNER BROTHERS (BIRMINGHAM), LTD., Cliveland Street, Birmingham (Aston Cross 2807).—Specialists in high-grade press tools, jigs and fixtures. Equipped for production. Six jig borers, including three by Société Genevoise.

389 BRITISH MECHANICAL PRODUCTIONS, LTD., 79a, Rochester Row, London, S.W.1 (Victoria 3541/2, 3516).—Repetition work for the aircraft industry, with A.I.D. inspection; jigs, tools and fittings; mouldings and pressings, plastics moulding machinery; turned and threaded insulators of all kinds in various materials; electrical and radio fittings, including "Clix" specialities; precision tools and gauges by associated company, the Pitter Gauge and Precision Tool Co., Ltd.

390 CORK MANUFACTURING CO., LTD. (Associated with Flexo Plywood Industries, Ltd.), "Langite" Works, South Chingford, London, E.4 (Silverthorn 2666).—"Langite" jointing (approved by A.I.D.) for rocker, sump, valve and inspection cover joints, jettison-valve joints, protecting strap for petrol tanks, etc.; resists oil, petrol, benzol, naphtha, turpentine, acetone, methylated spirits, carbon tetrachloride and other solvents.

391 BOWMAKER, LTD. Head Office: Bowmaker House, Bournemouth (Bournemouth 7070). London Office: 26, St. James's Street, S.W.1 (Whitehall 9901). Industrial bankers. Facilities to the aircraft industry and to the public for the acquisition on hire-purchase terms of aircraft, plant and machinery, equipment, hangars and buildings, etc. Forty provincial branches.

392 STREAM-LINE FILTERS, LTD., Hele-Shaw Works, Ingate Place, London, S.W.8 (Macaulay 1011).—Filters for reconditioning used lubricating oil from aircraft, road vehicles, diesel engines, testbeds, etc.

393 W. AND A. WILLIAMSON AND CO., LTD., 72, Brewery Road, London, N.7 (North 1641).—Petrol tanks (De Bergue riveted and welded and soldered types), oil tanks, water tanks, radiators, exhaust pipes and all types of sheet-metal work

394 THE GOLDSMITHS AND SILVERSMITHS CO., Ltd., 112, Regent Street, London, W.1 (Regent 3021).—Sterling silver presentation models of aircraft; brooches in diamond and enamel, gold and enamel, etc., with R.A.F. badges; cigarette cases, vanity cases, lighters, cuff links, etc., with R.A.F. badges or (to special order) aero club badges; shockproof, dustproof and weatherproof watches.

395 BURTONWOOD MOTOR AND AIRCRAFT ENGINEERING CO., LTD., Burtonwood, Warrington, Lancs (Newton-le-Willows 3311).—Precision machining and grinding of aircraft components; aircraft assemblies; A.G.S. parts; mass-production of gudgeon pins; case-hardening; nitriding.

396 PREMIER AEROMODEL SUPPLIES, 2a, Hornsey Rise, London, N.19 (Archway 2376).—Materials for the construction of experimental, display and educational aircraft models.

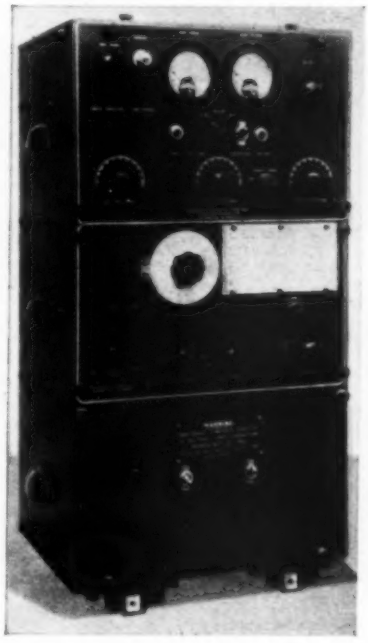
397 A. C. WICKMAN, LTD., Coventry (Coventry 4145).—All machines for the fabrication of metal aircraft components, including hydraulic drawing presses, press brakes, special double-crank presses with large bed area, automatic punching and riveting machines, metal shrinking machines, sheet-metal flanging machines, beading machines, wheeling machines, power hammers, drop hammers, folding machines and guillotine shears.

398 INTERNATIONAL ALLOYS, LIMITED, Buckingham Avenue, Slough (Slough 1096).—Aluminium and aluminium alloy ingots to all specifications for sand-cast, die-cast, pressure die-cast, etc., as used by the leading manufacturers for every type of work in connection with motors and general engineering.

399 WORCESTER SHEET METAL AND PRESSINGS COMPANY, Worcester (Worcester 1669).—Specialists in manufacture of aircraft radiators, oil coolers, fuel, oil and water tanks of De Bergue riveted or welded construction. Sheet-metal parts, pressings and fittings in all metals.

400 ROTAX, LTD., Willesden Junction, London, N.W.10 (Willesden 2480).—Complete aircraft electrical apparatus. Rotax-Eclipse direct-cranking and inertia starters. Rotax magnetos (as used in Bristol, Mercury, Pegasus and Hercules engines and in *Mercury's* Napier engines. Generators, as used (1,000-watt type) with Rotax equipment in Short boats. Small motors for flap and undercarriage operation. Rotax-Harley landing lamps; Rotax-Eclipse vacuum pumps to operate instruments and de-icers; small motors for operating controllable cooling gills; navigation lamps, batteries, switchboards, fuse boxes, portable floodlights, etc.

401 J. V. RUSHTON, LTD., Anodic Works, Birmingham New Road, Wolverhampton (Bilston 41711); 12-14, Bath Row, Birmingham (Mid. 5801); Whitcher Place, London, N.W.1 (Gulliver 4438).—Anodisers of aluminium and its alloys to A.I.D. specification and otherwise; black aluminium and duralumin, the new approved finish; also cadmium, chromate, and nickel finishes.



In the Hermes aircraft radio set, transmitter, receiver and rotary converter are combined in a neat unit measuring 22 in. by 12 in. by 9 in. and weighing only 43 lb. (General Aircraft, Ltd.—Para. 452.)

402 BADDESLEY AIRCRAFT, LTD., North Baddesley, Southampton (Rownhams 226).—Sub-contract work for military or civil aircraft. Air Ministry "705" approval. Heat treatment; assembly of components; metal or wood machine work; design and construction of light aircraft.

403 THE EN-TOUT-CAS CO. (SYSTON), LTD., Syston, Leicester (Syston 86177).—Specialists for many years in the construction of aerodromes and landing grounds; drainage, seeding, land clearing, etc.; erection of buildings, including hangars, administration blocks, hostel blocks, machine gun ranges, etc.; installation of sports facilities, comprising squash rackets courts, hard tennis courts, etc.

404 EXACTOR CONTROL CO., LTD., Exactor Works, Alperton, Middlesex (Wembley 1715 and 1716).—Exactor hydraulic controls, manufactured in accordance with Air Ministry requirements, for the operation of constant-speed airscrews, throttles, mixture controls and landing lamps.

405 BRITISH TYRE AND RUBBER CO., LTD., Thames House, Millbank, London, S.W.1 (Victoria 3848).—B.T.R. pulsator-type de-icing equipment for leading edges, etc., approved in Air Ministry Order No. 27 of 1938 under the name "Goodrich"; special equipment for the protection of airscrews, by means of which de-icing solution is spilled on to the blades through a slinger ring mounted at rear of hub.

406 VOKES, LTD., Putney, London, S.W.15 (Putney 5851).—Air intake filters; lubricating oil filters and fuel filters; oil filters for gun turret pumps, hydraulic retractable undercarriages, automatic pilots, etc.; air and oil filters for test-beds, etc.; air straighteners, etc.

407 J. R. BRAMAH AND CO., LTD., Devonshire Street, Sheffield, 3 (Central 24228/9).—Aircraft sheet-metal work of all kinds, engine cowlings, fairings, ankle cuffs, tail plane fillets, spats, ammunition boxes, chutes of every description, etc. Spinnings up to 8in. diameter, either in the rough or finished, any material; special plant and shops for this work, under own A.I.D. Approved Inspection Organisation. Contracts large or small carried out to Government Specifications.

408 JAMES A. JOBLING AND CO., LTD., Wear Glass Works, Sunderland (Sunderland 2882).—Boundary-light lenses; wireless insulators; floodlight lenses; neon tubing for airport beacons.

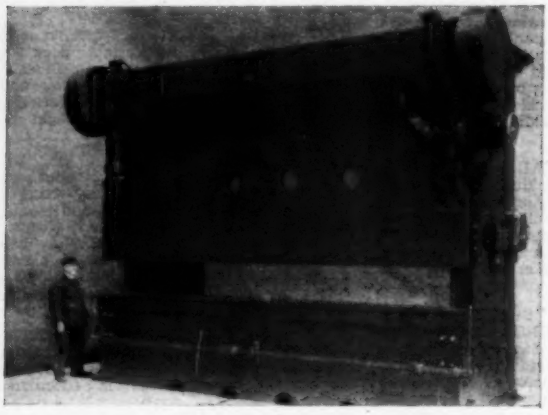
409 DENT AND CO. AND JOHNSON, LTD., Linwood, near Paisley (Johnstone 109).—Compasses, Air Ministry and civil types.

410 HILLIER, PARKER, MAY AND ROWDEN, 27, Maddox Street, London, W.1 (Mayfair 7666).—Auctioneers and surveyors. Specialists in the disposal of all kinds of business and industrial property, and the sale and valuation of plant and machinery, etc., throughout the British Isles.

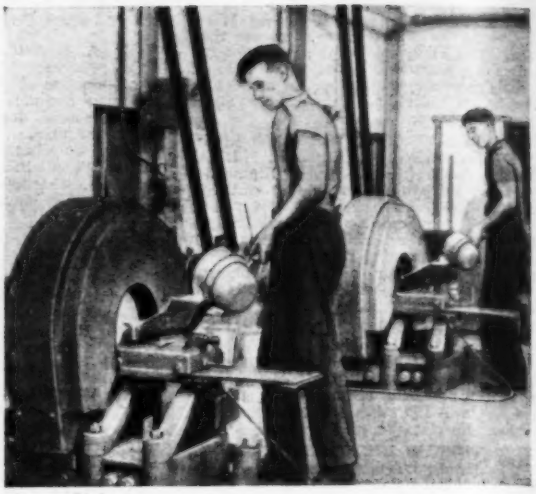
411 ROZALEX, LTD., Yorkshire House, Cross Street, Manchester, 2 (Blackfriars 6770).—"Rozalex" protective skin creams, for application before work, to protect the skin against dirt, weather conditions, and industrial irritants, and to keep the hands clean and in a healthy condition.

412 BURBERRYS, LTD., 18, Haymarket, London, S.W.1 (Whitehall 3343).—Outfitters to the Royal Air Force. Holders of the appointment to the Royal Air Force College, Cranwell, for the last 18 years, and can supply at short notice uniforms, flying kit, weatherproofs. Specialists in equipment for long-distance and test flights. Naval, military and civilian clothing of all descriptions.

THE ANCILLARY INDUSTRY (CONTINUED)



A 200-ton folding press, with 16ft. 8in. effective working length. (Henry Pels & Co., Ltd.—Para. 381.)



Pouring " spun pot " castings for piston rings in the foundry of Wellworthy, Ltd. (Para. 73).

413 THE EDISON SWAN ELECTRIC CO., LTD., 155, Charing Cross Road, London, W.C.2 (Howard 1234).—Royal " Ediswan " Escura electric discharge lamps; Royal " Ediswan " incandescent electric lamps; " Ediswan " lighting equipment. Lighting Engineering Section provides technical advice and complete specifications for lighting all classes of industrial machine shops, production plant, assembly sheds, and for the floodlighting of hangars, aerodromes and slipways.

414 R. B. PULLIN AND CO., LTD., Phœnix Works, Great West Road, Brentford, Middlesex (Ealing 0011).—Makers of electrically driven bank and turn indicators and " Godsave " direction finders. Sole selling agents throughout the world: Korect Depth Gauge Company, Ltd., Purley Way (Corner of Mitcham Road), Croydon, Surrey.

415 SCINTILLA, LTD., 20, Carlisle Road, The Hyde, Hendon, London, N.W.9 (Colindale 8844).—Vertex magnetos for four- and six-cylinder light aircraft engines, Scintilla magnetos types KV for 7, 9, 12, 14 and 18-cylinder aircraft engines. All magnetos can be supplied fully screened for use in connection with any type of screening harness.

416 I.C.I. (PLASTICS), LTD., Nobel House, Buckingham Gate, London, S.W.1 (Victoria 8432).—" Perspex " brand of transparent synthetic resin in sheet form, supplied to Air Ministry specification D.T.D. 339—light in weight, proof against atmospheric conditions, sea water and low temperatures, and can be shaped and machined accurately. Approved by the Air Ministry for transparent structures on all types of aircraft.

417 LIGHTNING FASTENERS, LTD., Kynoch Works, Witton, Birmingham (Birchfields 4848).—" Lightning " zipp fasteners (Type 4, extra heavyweight) for aircraft inspection vents in three shapes: triangular flap made by two zipps of equal length or one double the length of the other; circle, for which curved fasteners of 9in. radius are supplied; and really large flap with one length of zipp, partly curved and partly straight. No. 6 heavyweight zipp used for clothing.

418 NOBEL CHEMICAL FINISHES, LTD., Nobel House, Buckingham Gate, London, S.W.1 (Victoria 8432).—Approved suppliers to the aircraft industry and contractors to H.M. Government for dopes and finishing materials for metal, plywood- and fabric-covered aircraft, including latest Air Ministry specifications D.T.D. 260, 308 and 314. Universal primer, conforming to specifications X16 and D.T.D. 235, 260, 308 and 314. Special high-gloss finishes for civil aircraft giving a pleasing finish with minimum number of coats. Impregnating sealing varnishes for sealing pores of light alloy castings. Kemies heat-resisting paint for exhaust manifolds and A.C.P. Deoxidine pretreatment.

419 I.C.I. (METALS), LTD., Kynoch Works, Witton, Birmingham (Birchfields 4848).—On Air Ministry's list of approved suppliers. Aluminium alloys in strip and sheet manufactured to latest B.S.I. and D.T.D. specifications. Brass sheet and strip for radiator frames; water heater and petrol tanks; brass rod and extruded sections for windscreens and general engineering work; brass and phosphor-bronze wire for controls; copper piping for oil and fuel feeds; radiator tubes in brass and cupro-nickel; pressings for fire extinguisher bodies; nuts, bolts, washers, etc.

420 SMALL ELECTRIC MOTORS, LTD., Eagle Works, Church Fields Road, Beckenham, Kent (Beckenham 0066).—Sparking-plug runners, with predetermined torque limits, aircraft generators, ventilating fans and electric motors of all types.

421 BURTON, GRIFFITHS AND CO., LTD., Sparkbrook, Birmingham (Victoria 2121-24).—Wide range of machine tools used extensively in the aircraft industry, including Landis grinding machines, Milwaukee milling machines, Lodge and Shipley lathes, Maag gear grinding machines, Ex-Cell-O fine-boring machines, Potter and Johnston automatic chucking machines, B.S.A. single-spindle automatics, centreless grinding machines, etc. Comprehensive line of small tools also available, including Rotax electric tools, Solex gauges, Namco die heads, B.S.A. milling cutters, twist drills, taps, dies, reamers, etc.

422 CORFIELD AND BUCKLE, LTD., Trafalgar Works, Station Road, Merton Abbey, London, S.W.19.—Makers of aircraft components, on Air Ministry list and fully A.I.D. approved; suppliers of spinnings, pressings and general assemblies to the principal aircraft manufacturers; general machining.

423 VICKERS - ARMSTRONGS, LTD., Aviation Works at Weybridge, Surrey (Byfleet 240), and Supermarine Works, Southampton (Woolston 88201).—Vickers aircraft accessories for the aircraft industry generally; Vickers oleo-pneumatic shock-absorber legs as used for the retractable undercarriages of the Wellington, Walrus, Wellesley and Spitfire aircraft, also for the Bristol Blenheim, Hawker Hurricane, Blackburn Skua and Handley Page Hotspur and Hampden.

424 MECHANISM, LTD., Gyro Works, Croydon, Surrey (Croydon 4240).—Makers of gyroscopic aircraft instruments for which Smith's Aircraft Instruments, Ltd. (Para. 87), are sales agents. Also manufacturers of navigation lights in standard and small racing aircraft types; external and internal landing lights; fuel, oil and air pressure gauges; sensitive rigging spirit levels; time-of-flight clocks; vibration tables; mercury columns and other laboratory-testing plant.

425 THE G.Q. PARACHUTE CO., LTD., Stadium Works, Woking, Surrey (Woking 121), and 6, Queen Anne's Gate, London, S.W.1 (Whitehall 3211).—Manufacturers of man-dropping parachutes of all types for every purpose, including the G.Q. " Parasuit," a flying suit incorporating parachute and harness as integral parts. Glider-type parachutes a speciality. Also manufacturers of parachutes for supply dropping and flares.

426 B. SUNLEY AND CO., LTD., Sunleys Island, Great West Road, Brentford, Middlesex (Ealing 3070).—Specialists in Royal Air Force and Civil airfield construction; aerodrome extension; maintenance; public works and civil engineering contractors; muck-shifting contractors. Estimates without obligation. Contractors to His Majesty's Government.

427 S. AND R. J. EVERETT AND CO., LTD., 939, London Road, Thornton Heath (Thornton Heath 3252).—Manufacturers of tubular rivets as used in Short Empire flying boats; tubular rivets to all specifications; turned A.G.S. parts; small assemblies; fine tubing.

428 J. J. HABERSHON AND SONS, LTD., Holmes Mills, Rotherham, Yorks (Rotherham 1069).—Makers of strip and sheet steel to all Air Ministry specifications.

429 HENRY MEADOWS, LTD., Fallings Park Engine Works, Wolverhampton, (Fallings Park 31041).—Petrol marine engines from 8 to 100 h.p. for high-speed launches, suitable for co-operation with seaplanes and flying boats; lighting sets for ground services; Diesel engines, 40 to 100 h.p., marine and stationary.

430 JOHN LYSAGHT, LTD., Constructional Dept., Netham, Bristol (Bristol (Bristol 77065).—Constructional steelwork for the aircraft industry, hangars, etc.

431 MARTIN-BAKER AIRCRAFT CO., LTD., Higher Denham, near Uxbridge (Denham 714).—Aircraft constructors; makers of the Martin-Baker wind direction indicator.

432 HADFIELDS (MERTON), LTD., 131, Western Road, Mitcham, Surrey (Mitcham 2234).—Manufacturers of cellulose finishes, lacquers, paints and varnishes to Air Ministry and other specifications; also manufacturers of all types of commercial lacquers, varnishes and paints.

433 LORIVAL MANUFACTURING CO., LTD., Norwood Works, Southall (Southall 1014).—Fine mouldings in synthetic resin, urea-formaldehyde and cellulose acetate materials; also manufacturers of a large variety of mouldings in special materials for aircraft components.

434 METROPOLITAN - VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17 (Trafford Park 2431).—Motors, generators, control gear, instruments, switchgear, etc., for aircraft factories. Non-ferrous alloys for aircraft construction. Instruments for aircraft.

435 McGRAW-HILL PUBLISHING CO., LTD., Aldwych House, London, W.C.2 (Holborn 0056).—Publishers of technical books, of which the following are of interest to the aviation industry:—*Aerial and Marine Navigation Tables*. By John E. Gingrich (15s.); *Air Navigation (British Empire Edition)*. By P. V. H. Weems (30s.); *Airplane Design: Volume 1.—Performance*. By Edward P. Warner (36s.); *The Airplane and Its Engine*. By Charles H. Chatfield, Charles F. Taylor and S. Ober (18s.); *Airplane Maintenance: A Textbook for Airplane Mechanics*. By John H. Younger, Allan F. Bonnalie and Naire F. Ward (18s.); *Seaplane Maintenance*. By William Nelson (21s.); *Structural Design of Metal Airplanes*. By John E. Younger (24s.); *Synoptic and Aeronautical Meterorology*. By Horace Robert Byers (21s.); *Technical Aerodynamics*. By K. D. Wood (21s.).

436 WM. TURNER AND BROS., LTD., Eyre Lane, Sheffield, 1 (Sheffield 20333).—"Kismet" air compressors; air towers; inflating outfits and accessories pertaining thereto.

437 BRITISH INSULATED CABLES, LTD., Prescot, Lancs (Prescot 6571).—Aircraft cables to Air Ministry specifications. Manufacturers of aluminium and aluminium alloy sections and rods, and aluminium sheets and matting. Other materials to Air Ministry requirements include bare copper strand, wire, strip and rod, flexible bonding conductors in braided copper, cotton- and silk-covered wires, enamelled wires and stranded enamelled aerials, fuse wires of all types, welding rods and soldering fluxes. Materials for factory equipment: Cables; paper pinions for silent and resilient drives; resistance welders; electric riveting machines; electro-magnetic moulding machines for foundries.

438 AMERICAN AIRCRAFT AND ENGINE SERVICE, LTD., Airport of London, Croydon (Croydon 0031).—Service, maintenance and overhaul of such transatlantic products as Stinson, Lockheed, Beechcraft, Cessna, Porterfield and any other American aircraft, and Wright, Lycoming, Warner, Continental and other engines. C. of A. renewals and complete engine overhauls of any U.S. types.

439 SURREY FLYING SERVICES, LTD., Airport of London, Croydon (Croydon 3421).—Charter, pleasure and instructional flying (for "A" and "B" licences); ground engineers' training ("A" and "C" G.E. licences); variety of courses. Service and overhauls to aircraft and engines of all types; S.F.S. Service Engine Scheme whereby operators may keep their aircraft in service whilst their own engines are being S.F.S.-overhauled. Agents for the American Beechcraft, Porterfield and Cessna aircraft and Warner engines; also operators of No. 31 Elementary and Reserve F.T. School at Gloucester.

440 J. B. CARR, LTD., Tettenhall, Staffs (Tettenhall 51207).—Speedy preparation, using modern methods, of landing grounds, including levelling, draining, tree-clearance and turfing. Advice on site selection.

441 ESSEX AERO, LTD., London East Airport, Gravesend (Gravesend 4043).—Specialists in record-breaking machines and engines—high-speed and/or longe-range complete overhauls, airframes and engines; C. of A. and repairs to all types; experimental aircraft development engineers; contractors to the War Office; jigs and tools; specialists in working Elektron and Inconel materials; makers of cowlings, petrol tanks, metal and wooden details; fabric-, metal- and ply-covered components.

THE ANCILLARY INDUSTRY (CONT.)

442 PARNALL AIRCRAFT, LTD., Yate, Bristol (Chipping Sodbury 150), and Oakcroft Road, Tolworth, Surrey (Elmbridge 6408).—Design and manufacture of aircraft (including the Hendy Heck) and aircraft components. Specialists in armament equipment for all types of aircraft and manufacturers of the F.N.-type of gun turret, developed by Capt. A. Frazer-Nash, and adopted by the Air Ministry.

443 NASH AND THOMPSON, LTD. Oakcroft Road, Tolworth, Surrey (Elmbridge 1168).—Designers and constructors of armament and other components for aircraft; designers of all the Frazer-Nash gun turrets as supplied to the Air Ministry.

One of the range of Sperry gyroscopical instruments—the Directional Gyro (Para. 12).

444 MACLAREN UNDERCARRIAGE CO., LTD., 1, Oxford Court, Cannon Street, London, E.C.4 (Mansion House 3232).—Proprietors of patents with relation to landing gear allowing aircraft to take off and land in a desired direction, such as on a strip airport, in all wind and weather conditions.

445 HENRY WIGGIN AND CO., LTD., Thames House, Millbank, London, S.W.1 (Victoria 5353).—Monel metal (nickel-copper alloy) for various aircraft and engine constructional purposes; Monel rivets; "K" Monel (amagnetic); Inconel, with high resistance to corrosive action of exhaust gases, and therefore particularly suitable for exhaust manifolds.

446 WM. COLLINS, SONS AND CO., LTD., 144, Cathedral Street, Glasgow, C.4 (Glasgow Bell 3430).—*Collins Aero Diary*, 1939, containing some 150 pages of data of value to the aircraft engineer and operator.

447 S. E. OPPERMAN, LTD., North Circular Road, Stonebridge Park, London, N.W.10.—Gear-cutting specialists; gear boxes for aircraft use; complete components, e.g., undercarriages, beaching chassis, flap-actuating systems, etc.

448 JAMES GIBBONS, LTD., Church Lane, Wolverhampton (Wolverhampton 20401).—Anodising to Air Ministry approval, also anodising by sulphuric acid process. Steel cycle racks, windows and general ironmongery suitable for aerodromes and aircraft factories, etc.

449 HELLIWELLS, LTD., Dudley and Walsall Airport (Dudley 2573/4).—Superstructures, wings, tailplanes, rudders; general sheet metal work, including De Bergue fuel tanks; machined parts, also necessary jigging and tooling; repairs, modifications and maintenance of complete aircraft.

450 CHARLES WESTON AND CO., LTD., 3, Portsmouth Street, London, W.C.2 (Holborn 0414); Works, Torrington Avenue, Coventry (Tilehill 66291/2).—Specialists in the manufacture of oil-sealing devices generally. Gits patent precision oil seals as used by the leading British manufacturers for aero engines, variable-pitch airscrews, magnetos, wheel brakes, gun turrets, hydraulic pumps, retractable undercarriages, etc., etc.

451 AVIATION ENGINEERING (MESSIER) CO., LTD., 52, Grosvenor Gardens, London, S.W.1 (Sloane 3860).—Retractable and non-retractable undercarriages and associated equipment for all types of aeroplane; hydraulically and pneumatically actuated mechanisms of all descriptions; aeroplane wheels and brakes; hydraulic and pneumatic armament controls; hydraulic remote controls.

452 GENERAL AIRCRAFT, LTD., London Air Park, Feltham, Middlesex (Feltham 2604).—Aircraft constructors. G.A.L. sensitive-control drop-hammers in all sizes for sheet-metal work. Sole concessionaires for Hermes "Transreceiver" ultra-light (43lb.) aircraft radio transmitter and receiver for operation on any wavelength from 5 to 1,000 m., c.w., m.c.w., or r.t. G.A.L. smoke-trail aerodrome wind-indicator, electric or oil-fired, with illumination for night use. Makers of gasproof stretchers for air ambulance and general purposes.

453 ZENITH CARBURETTOR CO., LTD., Honeypot Lane, Stanmore, Middlesex (Wordsworth 2213).—Carburettors in various sizes, to suit large and small aero engines—as used on a new model, of well-known make, shortly to appear.

454 HEAD, WRIGHTSON AND CO., LTD., Thornaby-on-Tees, Stockton-on-Tees, London and Johannesburg.—Steel and alloy castings, structural steelwork, foundry plant, etc.

455 T. F. AND J. H. BRAIME, LTD., Ingham Street, Leeds, 10 (Leeds 27491).—Sheet-metal pressings for the aircraft industry.

456 YORKSHIRE COPPER WORKS, LTD., Leeds, 10 (Leeds 75431); Scottish Works: Barr Head, Glasgow.—Tubes in copper, brass, aluminium and all non-ferrous alloys.

457 R. J. COLEY AND SON (HOUNSLOW), LTD., Jubilee Works, Chapel Road, Hounslow (Hounslow 2266).—Scrap metal and disposal merchants to the aircraft trade.

458 TIMBRELL AND WRIGHT MACHINE TOOL AND ENG. CO., LTD., Slaney Street, Birmingham, 4.—Capstan and other lathes and machine tools for the aircraft and allied industries.

459 EVERSLEY PRESS, LTD., 34, Craven Street, Strand, London, W.C.2.—Publishers of *Martin's Air Navigation* (revised edition), by C. W. Martin; 25s.

460 W. H. COLE AND CO., LTD., Zona Works, Cheltenham.—Presswork of all classes for the aircraft industry; sub-assemblies; heat-treatment.

461 BIRMABRIGHT, LTD., Dartmouth Road, Smethwick, Birmingham (Smethwick 1213).—"Birmabright" aluminium-magnesium alloy, having exceptionally high resistance to corrosion, especially by sea water; in castings, sheet, tube, extruded sections, etc.

462 THE PLESSEY COMPANY, LTD., Vicarage Lane, Ilford, Essex (Ilford 3040).—Designers and manufacturers of pumps of all types, including the Pesco fuel, hydraulic and vacuum pumps; also the Coffman combustion starter.

463 SANDVIK BRITISH AGENCY, Norwich Union Chambers, Congreve Street, Birmingham, 3.—On Air Ministry list for steels for aircraft work; billets, hollow blooms, cold-rolled strip, etc.

464 ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1 (Waterloo 3333).—Publishers of books, including *"Flight" Handbook* (3s. 6d.), by W. O. Manning, F.R.Ae.S., and the technical staff of *Flight*—a handbook explaining in semi-technical style the theory and practice of flying and reviewing, the elements of aircraft design and construction.

465 EUSTON IGNITION CO., LTD., 329, Euston Road, London, N.W.1 (Euston 3026).—Magneto repairers officially approved by Air Ministry; B.T.H. service magnetos and spares in stock for immediate delivery.

466 G. TAYLOR (BRASS FOUNDERS), LTD., All Saints Street Works, Bolton (Bolton 158).—Makers of the "Okill" indicators for quick measurement of compression, combustion and fuel injection pressures in I.C. engines.

467 DE BERGUE'S PATENTS, LTD., Strangeways Ironworks, Manchester.—Holders of the manufacturing rights of the De Bergue riveting process, as used for the tanks of *Mercury* and other famous aircraft.

468 JABLO PROPELLERS, LTD., Trafford Park, Manchester (Trafford Park 2661) and Brettenham House, London, W.C.2 (Temple Bar 1841).—Airscrews in improved wood, with Jablo transparent protective coating and rubber leading edges, under Hugo Heine patents, for which Jablo Propellers, Ltd., are licensees in Great Britain and the Dominions; now specialising in detachable wooden blades for v.p. and c.p. hubs, such as the Rotol and the D.H.-Hamilton.

469 BARROW HÆMATITE STEEL CO., LTD., Barrow-in-Furness, Lancs.—Steel for the aircraft industry, especially precision-ground bright rounds, ¼in. to 4in. diameter, in all classes of steel, to War Office, Admiralty and Air Ministry tests and specifications. Ground to B.S.S.32 limits, or limits as fine as 0.0005in. Bars supplied normalised or heat-treated, tempered, etc.

470 FREDK. MOUNTFORD (BIRMINGHAM), LTD., Fremo Works, Moseley Street, Birmingham, 5 (Midland 3488).—"Fremo" taper pins for various aircraft purposes.

471 SAMUEL GILL AND SONS, Lythall Lane, Coventry.—Makers of jigs, fixtures and drill heads; complete assemblies for the aircraft industry.

472 THE HENDERSON SAFETY TANK CO., LTD., Watergate House, 15, York Buildings, London, W.C.2 (Temple Bar 7435).—Henderson patent crash-proof and self-sealing fuel and oil tanks; interchangeable and made in wide range of shapes and sizes to suit all types of aircraft.

473 WINDOVERS, LTD., The Hyde, London, N.W.9 (Colindale 6396).—Components for the aircraft industry, including cowlings, seats, tailplanes, assemblies and small parts.

474 COVENTRY CLIMAX ENGINES, LTD., Coventry.—Coventry Climax motor units for emergency or standby electricity generation, or for building into mobile units such as floodlights, welding plant, etc.

475 HENRY ROSSELL AND CO., LTD., Waverley Works, Sheffield. London: 25, Victoria Street, S.W.1. Glasgow: 144, St. Vincent Street.—Specialists in machine-tool steels; twist-drills of "Super Victory" high-speed steel; "Blue Riband Victory" milling cutters (as used in production of Rolls-Royce Merlin) for heavy duty and fast cutting on nickel-chrome and other alloy steels.

476 COMMERCIAL STRUCTURES, LTD., Staffa Road, Lea Bridge Road, London, E.10 (Leytonstone 3678).—Comprehensive factory-establishment service, including the erection of a "C.S.-planned" factory laid out for modern production methods and the solution of all detail problems connected with putting a new works into operation.

477 FISHER AND LUDLOW, LTD., Albion Works, Birmingham.—Sheet metal work and presswork of all descriptions produced in large and comprehensive plant; any quality of material to A.I.D. specification.

478 CARLUX ELECTRICAL SERVICES, LTD., Nicholas Street, Chester (Chester 193).—Magneto servicing, under Air Ministry approbation, for B.T.H. and Rotax equipment, etc.

479 WRIGHT'S ROPES, LTD., Birmingham, 9.—Steel cables spun from finest British steel to Air Ministry and other specifications; non-corrodible cables and strands; cable fittings.

480 T. J. PRIESTMAN, LTD., Cupro Foundry, Leopold Street, Birmingham (Victoria 2581).—Non-ferrous alloys, including notched bars, ingots, forgings, extrusion billets, slabs, wire, sticks and shot.

481 JAMES BOOTH AND CO. (1915), LTD., Argyle Street Works, Birmingham, 7 (East 1221).—Large producers of extruded, rolled, stamped and drawn light alloys for the aircraft industry, including Duralumin, Elektron, D.2 and M.G.7 alloys. Airscrew blade forgings as supplied to well-known manufacturers.

482 WEYBURN ENGINEERING CO., LTD., Elstead, Surrey (Elstead 141).—Aero engine camshafts and other parts requiring a high degree of accuracy in machining and heat treatment.

483 TECHNICAL PLATINGS, LTD., 8, Luther Road, Teddington, Middlesex (Molesey 240).—Anodic treatment; cadmium, nickel, copper, chromium and tin deposition.

484 TRINIDAD LEASEHOLDS, LTD., 1, London Wall Buildings, London, E.C.2 (London Wall 1721).—"Regent" spirit to Air Ministry specifications.

485 G. ELLIS AND CO., Eagle Wharf, Eastway, London, E.9 (Amherst 1091).—Specialists in easily erected portable buildings; hangars for gliding clubs, light aircraft, etc.; buildings for C.A.G. accommodation.

486 ECLAIR DOORS, LTD., Priory Works, Shirley, Birmingham (Shirley 1155).—"Eclair" balanced doors, up to 250ft. wide, for aircraft hangars, etc., giving unobstructed opening when raised.

487 JOHN BULL RUBBER CO., LTD., Evington Valley Mills, Leicester (Leicester 24531).—Specialists in moulded synthetics and oil- and petrol-resisting rubber for the British aircraft and allied industries.

488 LATA BALSA PLANTATION WOOD, LTD., Ludgate House, 107, Fleet Street, London, E.C.4 (Central 2840).—Balsa wood for insulation, isolation and buoyancy, in any shape or length; balsa ply, etc.

489 ARTHUR LEE AND SONS, LTD., Sheffield, 9.—Aircraft steels to Air Ministry specification in strip, wire and bars, as supplied for Hawker Hurricane and other aircraft; also stainless steels.

490 ZWICKY, LTD., Slough, Bucks (Slough 332).—Makers of mobile refuelling units and equipment.

491 BROOK MOTORS, LTD., Empress Works, Huddersfield.—Makers of electric motors for factory power equipment and other purposes; discount allowance scheme on old motors.

492 EXPANDED RUBBER CO., LTD., Mitcham Road, Croydon, Surrey (Thornton Heath 3431).—Manufacturers of "Onazote," the lightest manufactured solid known—3 lb. to 7 lb. per cubic foot. Insulation value, 0.19 B.T.U.s. Easily moulded. Speciality—fairings, buoyancy and insulation.

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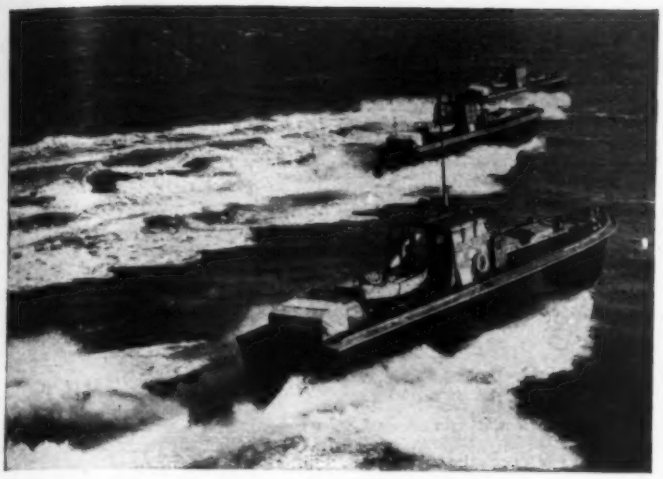

Scores of British Power Boats have been supplied to the R.A.F. Here are some now being delivered to the War Office—for towing gunnery targets at high speed.

AIR LIAISON MARINE CRAFT

What Three Builders are Offering

MARINE aircraft are being used in increasing numbers for both civil and military work, and there is a corresponding increase in the demand for watercraft of various types to perform duties in connection with the operation of such aircraft. Three marine engineering firms, in particular, have studied these requirements, and a brief review of their special productions in this sphere appears below.

British Power Boat Co., Ltd., Hythe, Southampton.—This firm has for many years specialised in the production of fast motor boats for air liaison work, building standard craft from 16ft. to 64ft. in length, to travel at speeds from 4 knots to 40 knots.

Under the direction of Mr. Hubert Scott-Paine, and using his designs, the company supplies these craft in quantities to the Royal Navy, the Army, and the Royal Air Force.

Probably the most outstanding example is the new ocean-going rescue vessel, an ultra high-speed craft designed primarily for long-distance aircraft rescue work. It has an exceptional performance in the way of load-carrying, and can be used for rapid transport of personnel, stores or equipment. The internal lay-out has been specifically planned for the handling of and accommodation of casualties, whilst the equipment includes specially designed crash gear, and complete radio and D/F. facilities. A considerable number has been delivered to the Air Ministry, and others are on order.

"Power" aircraft tenders are standard equipment in the R.A.F., and since the initial order was placed in 1931 there have been many repeat orders. The boats are noteworthy for their seaworthiness and manœuvrability. The latest types now being delivered are considerably faster than their predecessors, and are screened and bonded throughout for radio reception.

Specially noteworthy in the remainder of the range of 21 types are the armoured target boats used by the F.A.A. and R.A.F., the Empire control tenders and sea tugs used on the Empire air routes, the fast, small cargo-carrying sea freighters and sea coasters, planing dinghies for use as messenger boats and for refuelling and bomb-carrying purposes, and numerous other utility craft below 30ft. in length. The engines used are entirely British in design, origin and manufacture.

J. Samuel White and Co., Ltd., Cowes, Isle of Wight, who have built the majority of R.N.L.I. lifeboats, have concentrated of late years on producing a series of fast craft for various services, and for liaison work with aircraft they have refuelling tenders, baggage carriers, passenger carriers, crash tenders and target-towing launches of all types, with speeds up to 45 knots or even higher.

One of the range of fast motor craft built by J. Samuel White—a 45ft. launch used for torpedo recovery and capable of 45 knots.

A small launch is the 16ft. speed dinghy (fitted with White-Ford engine of 50 b.h.p.) used for ordinary tender work or refuelling duties; with three persons on board it has a speed of about 23 knots.

A somewhat larger launch, primarily designed for naval duties but adaptable for aircraft work, is the 25ft. boat engined with a converted Ford V8. This boat has a speed of 20

The floating fuel depot — a 45ft. Vosper refuelling tender.

knots, but can naturally be run at higher speeds with other suitable engines.

For crash tender work, the firm have 30ft. and 40ft. boats, single- or twin-engined, with speeds up to 30 knots if required. One recent 40ft. launch, built for the recovery of torpedoes, attained a speed of over 45 knots.

Whites are in a position to produce any type of high-speed boat that may be required for special service.

Vosper, Ltd., Portsmouth, have, during the last ten years, made a speciality of fast-planing craft ranging from their 13ft. light tender to 70ft. 47-knot motor torpedo boats.

All types of boats for co-operation with aircraft can be supplied, a good example being the 40ft. seaplane tender in service with the R.A.F.

Powered with three Vosper V8 engines, this boat has a speed of 24 knots fully loaded, and is specially designed for salvage work in heavy weather in addition to its normal duties. The after-cockpit has accommodation for 15-20 men.

Besides the seaplane tender, the Vosper 16ft. jolly boat, as supplied in quantity to the Royal Navy, is suited to a variety of duties at a seaplane base. It runs at 25 knots, powered with a Vosper 49h.p. engine. A portable cabin top aft gives good protection to a normal complement of six persons. Besides seaplane tenders Vospers supply to the R.A.F. a standard steel refuelling launch. Two thousand gallons of petrol are carried in the refuelling tanks, with pumping equipment capable of delivering 120 gallons per minute. Facilities for the supply of lubricating oil are also fitted.

HARD WORDS at the R.Ae.C.

An American Aviation Journalist Explains What He Thinks of This Country

Last Thursday's dinner, talk and discussion at the Royal Aero Club was private, in that members, and only members, were permitted to attend. Consequently, the speakers proceeded to express their views, in some cases, without too great a measure of caution. Attending as members of the club we were in a privileged position, and our report has, therefore, been pruned with care. We have, however, given the opinions expressed as far as these are suited to, and useful for, outside consumption.

DURING the last ten years or so there has not been such a considerable turnout of Royal Aero Club members as there was at the house dinner last Thursday. They had come to hear what Mr. Cy. Caldwell, the Associate Editor of the American aviation journal, *Aero Digest*, had to say about them. They certainly heard.

Knowing that they would not like what he had to say, he made a not-too-serious attempt to evade the issue, and after ten minutes of undiluted wit about nothing in particular, he sat down again. But the room demanded its punishment, and a moment later he was on his feet again.

In his opening remarks Mr. Lindsay Everard, who was in the chair, gave a few brief details of Mr. Caldwell's personal history and regretted the absence of the vice-chairman of the Club, Mr. Handley Page. The latter is probably the only person in the aircraft industry who could have replied really adequately, and in somewhat the same vein, to the visitor.

It would be impossible to give more than an impressionistic indication of what was actually said. Since he had no notes Mr. Caldwell jumped amusingly from one thing to another, and we, in our turn, must accordingly jump in the same way. One clear statement of our faults permeated the discourse; he considered that this country's position in internationl politics was a muddled and insecure one and that our attempts at half-hearted rearmament were equally muddled and insecure.

He opened by laughing loudly at the "pits" in our parks. These, it appeared, resembled Britain's whole attitude towards war and rumours of war. We refused to say that we were all out for peace, that we would not fight anyway, and that we would do anything to preserve this peace. We refused equally to say we are going to fight. If we had been all out for peace the pits would have been unnecessary; and if we knew that war was inevitable the pits would be dug properly—and there would be more of them. We simply dithered, hoping for peace but preparing for war.

In this opening attack lay the real gist of everything that Mr. Caldwell had to say. All his other remarks dealt with failures on similar lines—in other words, with our inability to face the facts and get on with the job.

Dealing with specific points in our aircraft development and production, he seemed to find that the works were well planned and fully capable of producing the aeroplanes requried. His only real complaint was that the places of production formed such magnificent targets. He cited Brooklands as a perfect example of such a target and claimed that within a few days of the start of hostilities Hawkers and Vickers would be no more. When he was at Bristol he was taken on to the roof of the new office building and was shown the vast expanse of the Bristol works, with the magnificent new road pointing the way in no uncertain manner for the benefit of the bomber pilots. At the Austin shadow factory, too, he was proudly shown the enormous one-piece erection shop, and the testing aerodrome alongside. Again, what a target.

With engine production he found little fault. He did add, however, that we built a beautiful engine like the Rolls-Royce with no frontal area to speak of, and then proceeded to put a thing "like a lady's handbag" under the fuselage with which to cool the water. He admitted that America had nothing like this engine, but excused the fact on the grounds that liquid-cooled development over their had virtually ceased many years ago. Even in those days, however, they were experimenting in the United States with surface-type radiators.

Bravely enough, Mr. Oswald Short was the first to take up the defence in the discussion which followed. He spoke of the difficulties which were encountered by a country with many loquacious parties and people of different ideas. He explained how the question of "arms or no arms" had been undecided for many years, and wondered, in the circumstances, whether freedom of thought could survive the stress of present-day conditions. By way of reply to Mr. Caldwell's opinion of our attitude to Czechoslovakia during the recent crisis he cited the United States' own attitude towards their commercial interests in China. Sooner or later America would need to fight Japan. Finally, and very modestly, he referred to the fact that metal stressed-skin construction had been successfully used (in the Short Silver Streak, *circa* 1920) many, many years before America started to make use of it.

Sir Robert McClean thought that the real trouble was in the vast number of expressions of opinion. Until these differences could be settled (or silenced) we should continue to be in difficulties when any crisis developed.

Our Difficulties

In spite of all the grumbling in which British people had always indulged, Sir Charles Bruce Gardner thought that we really were getting down to the business of aircraft production. The trouble started many years ago when there was almost complete disarmament and the few surviving manufacturers were only just able to keep going. With the sudden demand for more aeroplanes the Government necessarily had to go to those factories which were capable of turning out machines, whether or not these factories were laid out in vulnerable places. Later, more and more works would be erected well out of the bombers' way. In a democratic country it was no good attempting to go faster than the people themselves.

Major Alan Goodfellow suggested that things were not so very rosy in America. Mr. Tyler criticised the United States for making the League of Nations and Czechoslovakia, and then leaving them to their own devices.

Sqn. Ldr. Ira Jones exclaimed, quite rightly, that nobody had so far answered Mr. Caldwell's criticisms. You could have all the machinery in the world, but it was the man who did the actual fighting. We had them.

The only speaker to ask a direct and practical question about conditions in America was Flt. Lt. Christopher Clarkson. He asked how guns were fired out of the very pretty "blisters" on the Boeing "Flying Fortress," and why it was that in American Service flying accidents the victims seemed nearly always to be senior officers. To these questions Mr. Caldwell replied immediately. He said that these officers had to spend so much time on paper work in offices that they obtained no practice. When they did fly they were more likely to be killed. He cited the case of the chief of the Air Corps, Major General Westover, who was killed recently through spinning in off a gliding turn.

Mr. Caldwell had flown in the Boeing as a press observer, but on that flight no one was manning the gun turret in question. He suggested that it would be possible to fire from this point, but it was unlikely that the gunner would hit anything.

In his final reply to the discussion in general, he thanked the people in this country for the hospitality he had received.

COMMERCIAL AVIATION

THE WEEK AT CROYDON

"A. Viator's" Weekly Causerie on Transport Affairs : Ensign on the Job : To Land or Not to Land : Accommodation

IMPERIAL AIRWAYS' pilots would seem to be fully content with the *Ensign* and almost at once they began to land the big machine at Croydon after dark. Towards the end of the week I even saw it landing in quite a heavy mist. Pilots don't do that sort of thing with any machine which is not easy to handle.

Fog caused practically all airline machines—except a Swissair Douglas—to land outside Croydon on Tuesday last. The *Ensign* landed at Redhill, an excellent but somewhat small aerodrome for a machine of that size. Hearing of it, one of our bird-of-ill-omen-type reporters set off at full speed for Redhill to watch the take-off, just in case. I am happy to be able to announce that the *Ensign* had taken off (perfectly) before he arrived and that all he saw was a tarmac crow with a sardonic eye. Kenley was used by a number of companies and the greatest courtesy was experienced from all ranks of Air Force personnel.

Capts. Horsey and Jones, of Imperial Airways, are still giving instruction on the *Ensign* to other pilots, though the machine is regularly on the Paris route. I believe there are no less than five of this class in the air off and on just now, so if you see *Ensign* with registration letters other than G-ADSR, it is not a rush of last night's party spirit to the back of the eyeballs. *Egeria* is almost ready for delivery, I believe, but the others are undergoing the slight modifications specified by Imperial Airways.

Amongst notable phenomena over Croydon last week was the basement of the Mayo composite complete with superstructure, which caused a visitor to remark that it was carrying its step ladder with it for unloading cargo.

History, like the radish, is apt to repeat itself. Years ago an old lady set off by air for Paris, but after about an hour's flying the machine had to return to Croydon. On landing she was fully convinced that she had crossed the Channel and reached her destination—a conviction supported by the large board which was over the entrance to Customs, bearing the word "Douane." We cannot do that in these days, otherwise it would have to be inscribed in some eight or ten languages. Nevertheless, only the other day another passenger was deceived in the same way. The machine returned and he was told he would have to wait for better weather.

"But I don't want better weather," was his reply. "I want a car to —" (I won't mention the Continental capital concerned) "as I have a lot of business to do there." It took some time to convince him that he was again at Croydon.

Influenced possibly by the arrival of the first *Ensign*, the passenger bookings to Paris by Imperials have been extremely numerous this past week, and several services have had to be duplicated.

Something closely resembling a goodish section of the Eiffel Tower on wheels has been seen gambolling across the tarmac behind a tractor lately. It is the platform used for working on the engines of this big machine, and not, as some have supposed, a device to allow the traffic staff to get (literally) even with the control people during QBI.

We must, I suppose, have something to make our blood run cold in our Sunday morning paper. Anyway, the horse-radish at lunch time will warm it up again. Last Sunday's funny air story was to the effect that "British Air Liners Can't Land in Fog." They have blind flying instruments, but do not use them. The story seems to have been based on the affairs during the fog of last week. Unfavourable comparisons were drawn between British and Swiss pilots because a Swissair machine landed during a period when the fog, doubtless, had lifted.

Bad Weather Limits

The story was unfair because no mention was made of the fact that British pilots were by no means the only ones not to land at Croydon during the day. French, German, Dutch, Swedish, Belgian and Czech pilots, all equal in skill to their Swiss colleagues, decided not to do so. The Lorenz beacons bring one to the landing field but do not put the machine on the ground. If visibility becomes nil, landing—there is no argument about it—becomes dangerous. Nobody who knows anything about the matter would blame pilots with human lives under their charge for refusing to take the risk, however slight, of coming in during really thick weather.

Another newspaper got hold of the good old story of lack of accommodation for aeroplanes at Croydon, and bewailed the fact that the £50,000 *Ensign* had to be tethered out at night because hanger space is all filled up. You would think this story exaggerated, wouldn't you? Knowing the devouring, all-consuming energy of Air Ministry departments, you would suppose that, having been warned in the columns of *Flight* and also by responsible air transport people repeatedly during the past five to eight years, something would have been done about hangar accommodation.

Driven into a corner by the persistent journalist, an official of the Air Ministry is said to have remarked, "Ample arrangements are being made. There is no danger of Croydon being overcrowded in the future." Just what the same practical joker said five years ago, word for word. Works and Bricks are said to have indented for a watchman's shelter in 1930, and to be still scanning far horizons for it.

The G-Class Boats

ON October 28 Imperial Airways took delivery of *Champion*, the first of its fleet of twenty-four-ton G-class Short flying-boats, of which eight have been ordered. The second boat, *Cabot*, should now be out. The other names, for those who are interested, are *Caribou, Connemara, Clyde, Aotearoa, Australia,* and *Awarua*.

The names of the last three, which have been changed since the original order was placed, give a clue to their destination They will be used on the projected trans-Tasman service between Sydney and Auckland, which should be in operation in February next year. Incidentally, Pan American Airways will be putting two of the new Boeing Clippers on the San Francisco-New Zealand service as soon as these machines are ready.

The new Short boats are, of course, designed primarily for long-range work and are strengthened to carry an additional 5½ tons in their all-up weight. The special equipment and modifications include those for refuelling in the air, and *Caribou* will shortly be flown to Felixstowe for official Air Ministry refuelling tests. Once in the air and after refuelling, the permissible loaded weight will be as high at 53,000 lb. The normal all-up weight of the G-class is 46,000 lb. In the meantime the long-range equipment is being left out of the new boats so that they can be used to cope with the Christmas rush of mails on the Empire routes. The maximum range of these new boats will permit delivery by air to Bermuda, for instance, should one of them be required for the New York service, on which *Cavalier* alone has so far been in use.

Public Safety

A COMMITTEE has been set up by the Secretary of State for Air "to examine the existing regulations governing the flight of aircraft over populous and other districts and the adequacy of the means of their enforcement"; in addition, any further measures which may be required to regulate such flying will be considered.

The Rt. Hon. Lord Gorell will act as Chairman, and Sir Lawrence Chubb, Sir Alan Cobham, Miss Pauline Gower, Mr. F. Montague, Sir Hugh Seely, Mr. W. P. Spens and Major R. H. Thornton will serve as members. Mr. E. W. Short, of the Air Ministry, will be the secretary of the Committee, which will start its investigations at once.

Commercial Aviation

QUICK-WORKING TABLES

New Assistance for the Astronomical Navigator

Hughes' Tables for Sea and Air Navigation, compiled by L. J. Comrie, M.A., Ph.D., 20s.; Henry Hughes and Son, Ltd., 59, Fenchurch Street, E.C.3.

DOCTOR COMRIE, late superintendent of H.M. Nautical Almanac Office, ably supported by Henry Hughes and Son, has succeeded in what appears to be the almost impossible task of producing a series of quick-working tables of accuracy sufficient not only for the air navigator and for the marine navigator, but even for the surveyor. Though no claim is made of originality in the three main quick-working tables, great care has been taken in the arrangement and typography: the accuracy of similar existing tables has been carefully checked, and extensive new computations undertaken as a result. The explanatory pages are helpful and concise, and are illustrated by numerous examples.

The principle upon which the Tables are based, for the sea and air navigator, is the familiar one of dividing the astronomical triangle into two right-angled triangles. An assumed D.R. latitude position to the nearest whole degree is chosen, the reason being that when working sights of more than one celestial body the latitude is the one common factor. The Local Hour Angle of the body is then found, also to the nearest degree, by finding the G.H.A. and assuming a D.R. longitudinal position which will make the L.H.A. a whole number when the assumed longitude is either added to or subtracted from the G.H.A. according to the usual rule.

With these two whole numbers of Latitude and Hour Angle, Table I is entered. Table I is arranged with a page for each latitude, with H.A. as argument. The latitude pages are extended up to the Pole, which is usually not the case. After taking out quantities from Table I and adding or subtracting, according to a simple rule, one of the quantities, K, to or from the declination, Table II is entered for Altitude and Table III for Azimuth, again according to simple rules. By laying out the figures in a suitable working manner there is almost an identity of form in finding the Altitude and the Azimuth; this assists the memory, if printed forms are not available.

Should intercepts be required from a more exact D.R. position (i.e., not using D.R. positions assumed to the nearest whole degree of latitude and Hour Angle), it is still possible to use the Tables by an additional calculation, of which a full explanation is given. This is a feature not usually found in this type of tables. The whole calculation is then approximately equivalent to working out the whole sight by the haversine-cosine method, but obviates the necessity of the bulky tables required for the latter method. The point to note is that the accuracy required by the sea navigator and surveyor is there; the air navigator can drop the decimal points and interpolations.

The miscellaneous Tables, so useful for odd purposes in navigation, have in many cases been rearranged in critical table form, and special tables for air work added. The Traverse Table has been rearranged in a condensed form. The Refraction Tables in particular have had a great deal of care and thought expended upon them, and alone greatly enhance the value of the complete work. The surveyor and sea navigator now, at last, possess tables giving the maximum of accuracy, should it be required. For air work, refraction for heights up to 35,000 feet is given to the nearest minute, which should certainly be ample.

Great Circle courses may also be computed according to the methods given. This is often not the case with other short-work tables, or is restricted to certain specified cases. The method of checking results by differences, when calculating a number of points on a Great Circle course, is also given.

Looking ahead, it is safe to prophesy that Hughes Tables will become standard when quick-working tables are required, either in the air or on the sea, in view of their arrangement and the care taken in their compilation and accuracy. Even when "direct-reading" tables become available, they will inevitably be bulkier in form and more expensive than Hughes Tables. When space, accuracy and price have to be considered, at the expense of a little mental effort, the Tables will find countless supporters.

Winter in Scandinavia

FOR the first time this winter D.D.L., A.B.A. and D.N.L. will maintain the Oslo-Gothenburg-Copenhagen service, and in future this will be operated throughout the year. The Moscow-Riga-Stockholm service officially ceased operations on October 15, but the Russian operating concern, Aeroflot, has announced its intention of keeping the service going without Swedish assistance during the winter months.

By Ensign to Paris

THE new A.W. Ensign of Imperial Airways made her first trip to Paris on Thursday, October 20, with a party of journalists. To accommodate all the passengers extra seats had been installed, which will be removed when this machine goes on the Eastern service, for which only twenty-seven passengers will be carried. The weather was perfect on the occasion of the trip, and Capt. Horsey kept the air speed down to round about 150 m.p.h. in order to give the passengers as good an opportunity as possible for forming impressions.

There can be no doubt that from the point of view of passenger comfort Ensign is a very good machine indeed. Among other things, a word of high praise is due to the catering and the attentions of the stewards; though it is only fair to add that this is not peculiar to Ensign, and is equally praiseworthy on other machines of Imperial Airways. The Short Empire boats have, however, set a very high standard of comfort which it will not be easy for Imperial Airways to improve or even to maintain, and in one or two ways this standard has not been quite maintained in the arrangements of Ensign. The saloons are not so quiet as they are in the boats, and one has to raise one's voice somewhat to carry on conversation, though the effort is much less than in, say, the old H.P. 42 class. The noise is most noticeable in the forward cabin, which is the smoking-room, and which is more or less in line with the airscrews. Still, talking is much less of an exertion than in a tube train.

The promenade is not in one of the saloons, as in the case of the boats, but in the corridor opposite the pantry which connects the smoking-room with the central saloon, and as one stands there one is apt to be jostled by people passing between these centres. This deprives the machine of one of the charms which is most appreciated in the boats. On Thursday most of the passengers who sampled the promenade soon gave it up and returned to their seats.

All-metal aircraft must tend to get hot inside when at moorings or standing on aerodromes in the East, and Ensign will probably get very hot. Air conditioning seems to be called for, and it would be a good thing if our designers would turn their earnest attention to this matter in the future. For the present, electric fans in each cabin would allay the discomfort of passengers until the machine climbs up into cooler air.

South Atlantic Passengers?

JANUARY—two months sooner than anticipated—is now stated by Air France to be the month during which they hope to be able to put the first two of their new fleet of five Liore et Olivier 47 flying boats into service on their South Atlantic route. This will bring to an end the long unbroken spell in which the four-engined Farman landplanes have been used on the ocean crossing and will probably make a new epoch in transatlantic history with the regular transport of passengers, as the LeO 47 is fitted with comfortable accommodation for four passengers in addition to its crew of five and 1,300 lb. of payload.

The first of the series has been flying for the past six weeks at the Etang de Berre and the second should by now have been put in the water. It will be remembered that the LeO 47 has four Hispano 12 Y moderately supercharged engines, variable pitch airscrews and slotted flaps; the machine takes off with full load in 27 seconds, and cruises at 187 m.p.h.

Tommy Vallette

FLIGHT—and everyone who knew him at Croydon and elsewhere—very deeply regrets the death, on October 20, of Mr. T. A. Vallette. His death was the result of injuries sustained in the accident earlier this year to a machine which was the first to be fitted with wireless control for an automatic pilot. Mr. Vallette, as a member of the staff of the Marconi Company, was in charge of the wireless side of its development.

He had been with the Marconi Company since 1928 and, apart from participation in various experimental and record-breaking flights, had flown, in the course of his duties, practically all over the Empire routes. He will be particularly remembered as one of the operators with *Caledonia* on the first of Imperial Airways' Atlantic crossings.